

Illinois State Water Survey
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THE ILLINOIS STREAMFLOW ASSESSMENT MODEL

Version 3.2

USER'S GUIDE

by
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Prepared for the
Illinois Department of Transportation
Division of Water Resources

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Evan P. Mills and H. Vernon Knapp

Illinois State Water Survey
2204 Griffith Drive
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1. INTRODUCTION TO ILSAM

ILSAM (The Illinois Streamflow Assessment Model) is a water resources management tool that provides statistical information on streamflow quantity, primarily for low and medium flows. ILSAM combines processed data from streamgage records and recent information on water use withdrawals and effluent discharges to provide its users with an assessment of the up-to-date changes in flow variability for all stream locations throughout a river basin. ILSAM can also simulate the potential effects of hypothetical water resources projects to provide its users with an estimate of future streamflow conditions. This information can be useful for evaluating the water supply for potable and irrigation use, potential conflicts in water use, wastewater effluent dilution standards, the design of reservoirs, and environmental impacts of water resources projects.

A list of river basins for which the ILSAM model has been developed is given in appendix C.

1.1 STREAMFLOW PARAMETERS ESTIMATED IN ILSAM

ILSAM produces information for 154 selected streamflow parameters, including flow-duration (flow versus percentage of duration) relationships, low flows for various durations, and expected return intervals. The 154 parameters are described in detail in the following paragraphs. All parameter values are given in units of cubic feet per second (cfs).

Estimates of all flow parameters are presented for both present and virgin (natural or unaffected) flow conditions. In addition, you may introduce a hypothetical (or potential) flow modification and have the model estimate its effect on the specified flow parameters; the resulting flow is called the altered flow. Row conditions may be estimated for any gaged or ungaged site in the river basin with a drainage area of at least 10 square miles.

1.1.1 ANNUAL FLOW-DURATION VALUES (PERCENT PROBABILITY OF FLOW EXCEEDANCE)

For a gaging station with a record of continuous daily discharge, the 2 percent flow (Q_2) is the streamflow volume that is exceeded on exactly 2 percent of the days during that period of record. The 1 percent flow (Q_1) is necessarily a larger volume because it is exceeded less often. A graph of some typical annual flow-duration values is shown in figure 1.

Parameters: Q_{99} , Q_{98} , Q_{95} , Q_{90} , Q_{85} , Q_{75} , Q_{60} , Q_{50} , Q_{40} , Q_{25} , Q_{15} , Q_{10} , Q_5 , Q_2 , Q_1 , and Q_{MEAN}

1.1.2 MONTHLY FLOW DURATIONS VALUES (PERCENT PROBABILITY OF FLOW EXCEEDANCE FOR EACH MONTH OF THE YEAR)

The monthly flow-duration values are just like the annual flow durations, except the values are determined using only those daily discharges that fall within a certain month of the year. For example, in a 30-year streamflow record, there are exactly 900 daily values for the month of April. The value for Q_{10} is the flow that is exceeded exactly 10 percent of the time, or on 90 days.

Parameters: Q_{98} , Q_{90} , Q_{75} , Q_{50} , Q_{25} , Q_{10} , Q_2 , and Q_{MEAN} ,

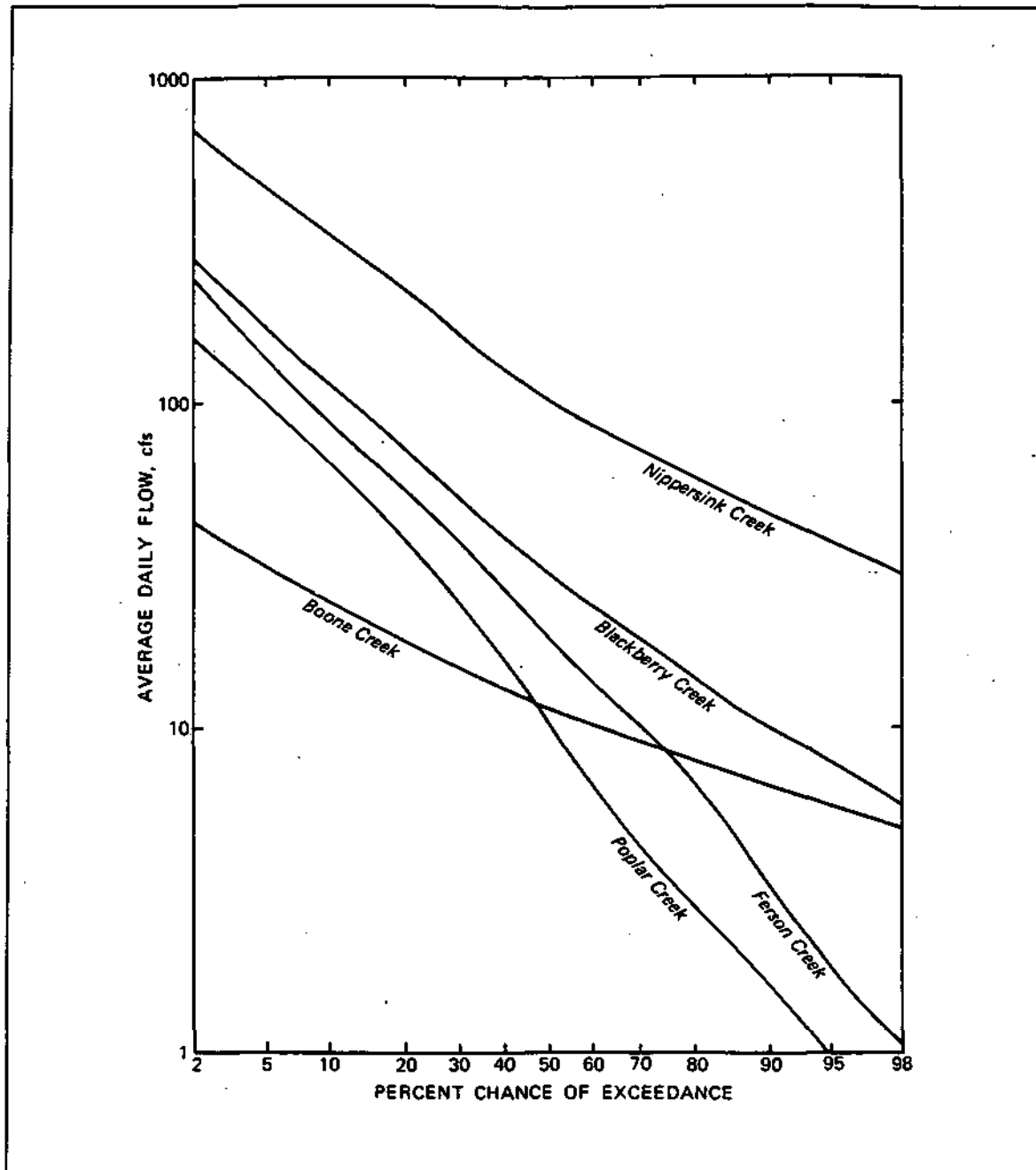


Figure 1. Some sample annual flow-duration curves
(from Knapp et al., 1988, *Fox River Basin Stream/low Assessment Model: Hydrological Analysis*,
Illinois State Water Survey Contract Report 454)

1.1.3 LOW-FLOW VALUES

Each low-flow parameter is defined by a duration in consecutive days and a recurrence interval in years. A 7-day low flow for a given year is the lowest average flow that occurred for any 7 consecutive days within that year. Figure 2 illustrates a daily hydrograph and both the 7-day and 31-day low flows that occur during this period. The 7-day, 10-year low flow is the 7-day low flow that occurred *on average* only once in 10 years. Low flows with a recurrence interval of more than 10 years will be lower in magnitude than the 10-year low flow. The 2-year low flow is the value expected to occur during an "average" year.

Durations: 1-day, 7-day, 15-day, 31-day, 61-day, and 91-day
 Recurrence intervals: 2 years, 10 years; 25 years, and 50 years

1.1.4 DROUGHT FLOWS

These flows are similar to low flows, except that the duration of the period is defined in months instead of days. The values are average low flows developed from monthly records (as opposed to daily records). These values are useful in determining reservoir yields for which drought severity over a lengthy period is a critical parameter.

Durations: 6-month, 9-month, 12-month, 18-month, 30-month, and 54-month
 Recurrence intervals: 10 years, 25 years, and 50 years

1.2 IDENTIFYING LOCATIONS IN THE WATERSHED

All locations identified in ILSAM occur along rivers and streams, which can be identified either by name or by an identification code. All sites along any individual stream are identified by the distance (in miles) upstream of the mouth or confluence of the stream. This distance is termed the river mile.

One of the data files used by ILSAM is the "network file", which lists the river mileage and site descriptions for a large number of locations along each stream in the watershed. The river mileages that identify these sites are taken from a larger listing given in Healy (1979, *River Mileages and Drainage Area for Illinois Streams*, U.S. Geological Survey Water Resources Investigation 79-111). Although this publication is out of print, copies of the complete listing for a particular watershed may be obtained from the Water Survey.

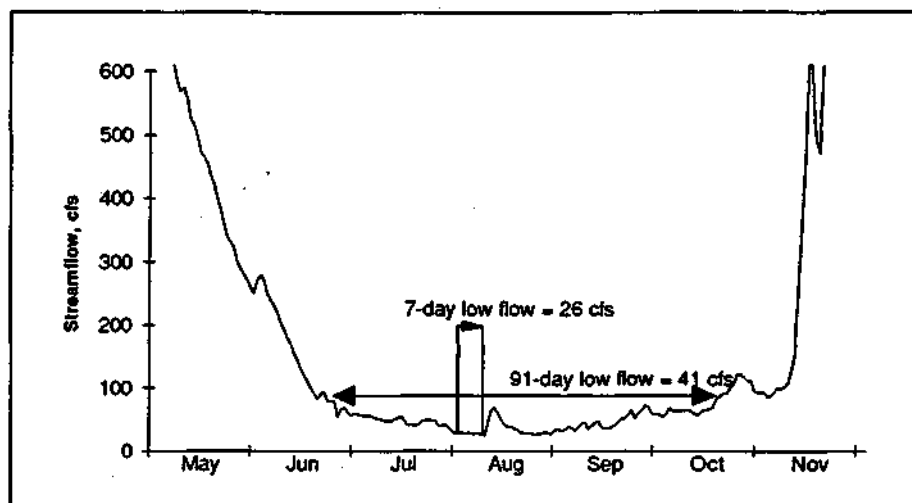


Figure 2. Estimation of the 7-day and 91-day low flows from the daily flow records

If the location of interest is not supplied in the network file (and therefore not among those listed by ILSAM on your computer screen), you may either choose the nearest point or insert your own by providing a river mile. The new river mile is best estimated by examining a detailed map of the area (such as a U.S. Geological Survey topographic map) and comparing distances along the stream with the upstream and downstream entries in the listing in the network file. In some cases, the more detailed Healy listing will be more useful than the listing given by ILSAM.

The network file also provides values for watershed characteristics (such as drainage area). If you insert a new river mile, the watershed characteristics are interpolated using the values at points listed in the network file. You may also choose to edit the network file listing to insert a new river mile for which information on the watershed characteristics has been computed.

Use of the model is not recommended for streams whose drainage areas are less than 10 square miles.

1.3 FLOW MODIFICATIONS

Flow modifications are considered to be any definite changes in the flow volume in the stream caused by a water resources project, such as a reservoir, water-use withdrawal, or wastewater treatment plant. Modifications to the flow regime induced by land-use changes, such as a change in vegetation or urbanization are not accounted for in the model. The hydrologic analysis used to develop the ILSAM model for each watershed examined information on all of the major flow modifications in the watershed, and the estimated effects of these modifications has been included in the data files.

The ILSAM model can also analyze the potential effects on the streamflow of a hypothetical or potential flow modification. To accomplish this, you must identify the location and category of the flow modification, and provide information concerning its quantity or size. ILSAM then computes the *altered* flow condition associated with the flow modification. You can introduce one of eight categories of modifications:

1. Municipal Effluent Discharge
2. Uniform Discharge
3. Uniform Withdrawal
4. Seasonal Discharge
5. Seasonal Withdrawal
6. User-Defined Discharge
7. User-Defined Withdrawal
8. Reservoir

These eight categories are defined to provide flexibility for easily describing the flow modification of interest. Each category assumes a certain distribution of the discharge or withdrawal over time.

1.3.1 MUNICIPAL EFFLUENT DISCHARGE

The municipal effluent discharge category assumes that the minimum and maximum discharges occur at approximately the same time as the lowest and highest flows in the stream, respectively. An annual flow-duration curve for the effluent discharge is constructed using information on the average daily and minimum monthly discharge, and is given a standard shape similar to that shown in figure 3. The average daily and minimum monthly discharges are assumed to be equal to the 40 percent and 98 percent flows (Q_{40} and Q_{98}), respectively. The values of all other flow parameters (low flows, drought flows, and monthly flow durations) are computed using a transformation from the annual flow-duration curve. The estimation of the $Q_{7,2}$, $Q_{91,10}$, and $Q_{7,10}$, illustrated in figure 3.

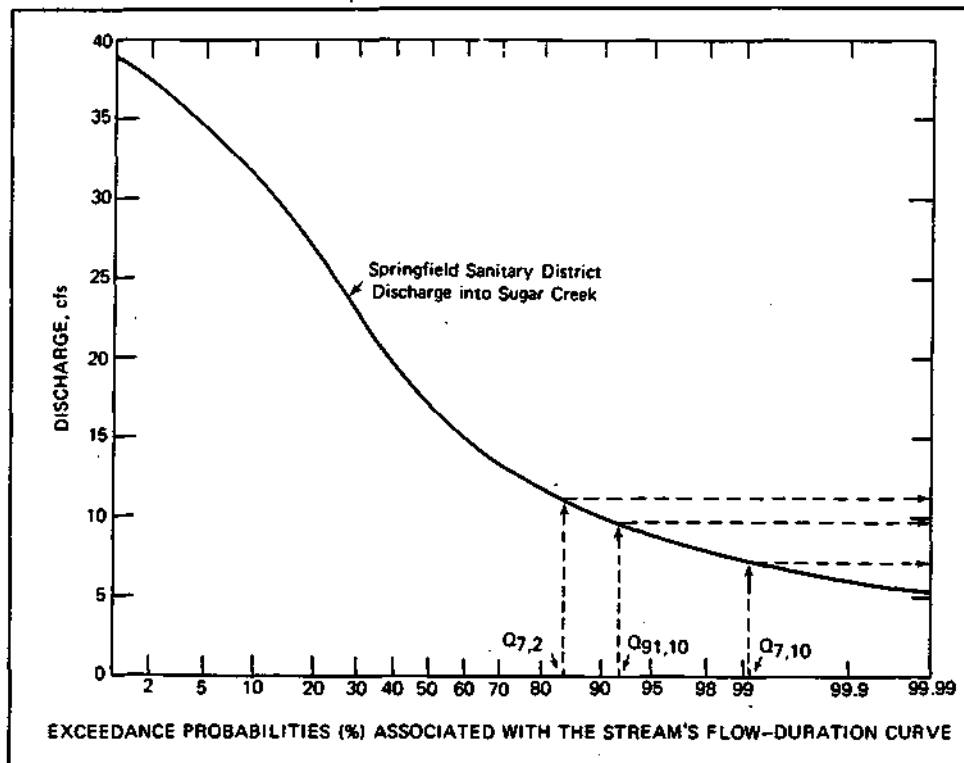


Figure 3. Transformation of the annual flow-duration curve to other parameters (from Knapp et al., 1985, *Stream/low Assessment Model for the Sangamon River Basin in Illinois: User's Manual*, Illinois State Water Survey Contract Report 358)

1.3.2 UNIFORM DISCHARGE

Supply a discharge amount. This discharge is assumed to occur at all times, therefore uniformly affecting all flow parameters.

1.3.3 UNIFORM WITHDRAWAL

Supply a withdrawal amount and, if desired, a minimum flow below which the withdrawal is assumed to cease. If a minimum flow restriction is not supplied, ILSAM then assumes that all available flow from the stream is withdrawn (figure 4). If a minimum flow restriction is supplied, then the withdrawal is equal to the amount provided *only* when the remaining flow is greater than the specified minimum flow. Otherwise, the withdrawal is zero. The resulting effect on the annual flow-duration parameters may not be uniform.

The estimation of the new flow-duration curve is illustrated by a two-step process in figures 5a and 5b. The first step (figure 5a), which estimates the altered flow condition at each point along the flow-duration curve, results in flow values that are out of order because they are not continuously decreasing from left to right. The new flow-duration curve is estimated by ordering these flows (figure 5b).

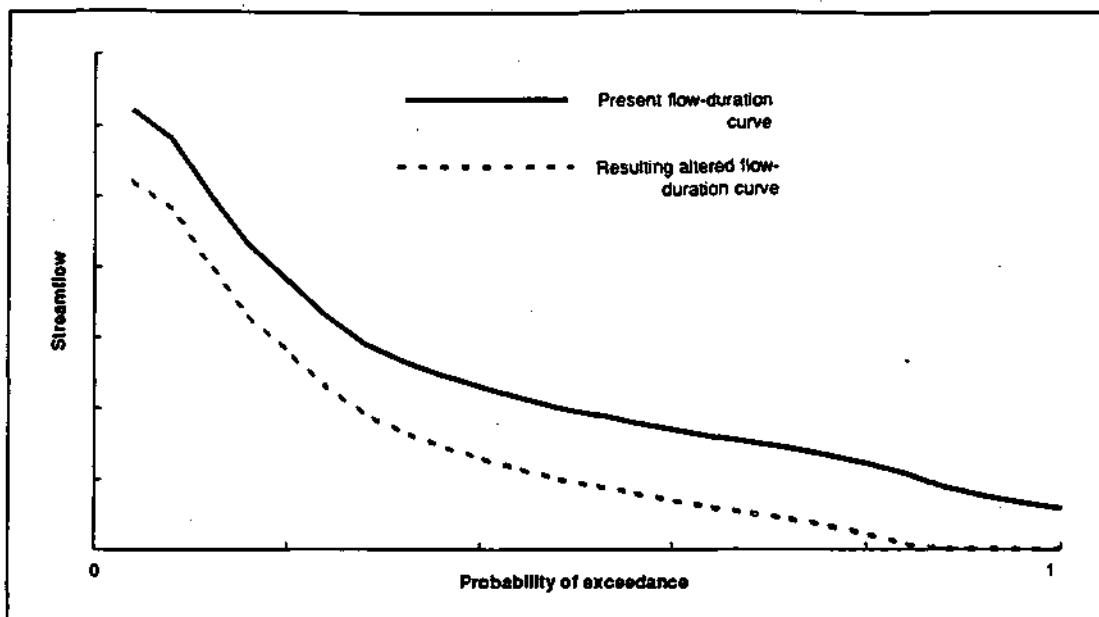


Figure 4. Effect of a uniform withdrawal (no minimum flow restriction) on the annual flow-duration curve

1.3.4 SEASONAL DISCHARGE

This category is similar to the uniform discharge, except that a separate discharge value can be provided for each of the 12 months. Monthly flow-duration parameters are estimated directly by adding the discharge amount. Altered flow conditions associated with the annual flow duration are reconstructed using the monthly flow statistics. Low flow and monthly drought parameters are estimated from a transformation of the annual flow duration.

1.3.5 SEASONAL WITHDRAWAL

Supply a uniform withdrawal and a minimum flow for each of the 12 months. The effect of the withdrawal on the altered flow duration for each month is computed, similar to the procedure by which the annual flow duration was recomputed for uniform withdrawals (illustrated in figures 4 and 5). Altered flow conditions associated with the annual flow duration are reconstructed using the monthly flow statistics, and low flow and monthly drought parameters are estimated from a transformation of the annual flow duration.

1.3.6 USER-DEFINED DISCHARGE

The first step in representing a user-defined discharge is to develop an approximate flow-duration curve for the modification. You may either enter separate discharge values for all of the 15 annual flow-duration parameters, or may enter 4 selected values from which the remainder of the flow-duration parameters are computed. The second method is termed the *minimal information option*. In both cases, the discharges associated with the low flow, drought flow, and monthly flow-duration parameters are computed by a transformation from the annual flow duration. This transformation process was briefly described under category 1.3.1, Municipal Effluent Discharge.

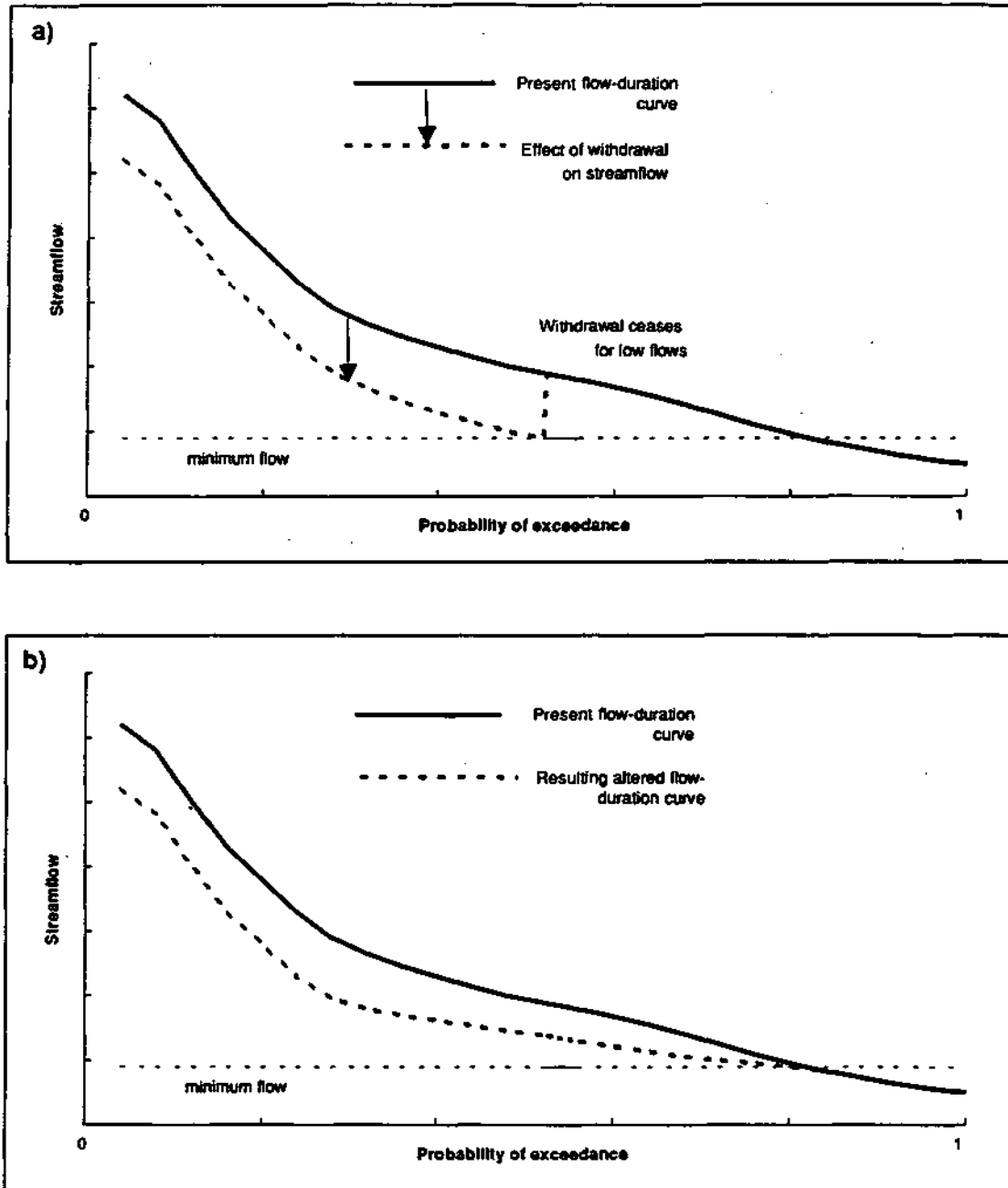


Figure 5. Estimating the effect of a uniform withdrawal (with minimum flow restriction) on the annual flow-duration curve:

- a) Step 1: computing altered flows from present flows
- b) Step 2: ordering altered flows

For the minimal information option, supply four values: 1) the average rate of discharge, 2) the minimum monthly rate, 3) the maximum monthly rate, and 4) the daily rate associated with the period of lowest streamflow. Designate whether the maximum rate of discharge occurs during wet or dry periods, i.e., periods of high or low streamflow. This determines if the fourth value (the daily rate) is to be a maximum or minimum value. If the minimum monthly rate is zero, then enter the percentage of time that the discharge is not zero.

Figure 6 (case 1) illustrates the minimal information option. The percent exceedance at which the average discharge occurs, DAVG, is placed so that the computed area beneath the curve is equal to the average discharge rate. In this case, the average discharge of 1.3 cfs is estimated to occur with a duration (DAVG) of 30 percent

1.3.7 USER-DEFINED WITHDRAWAL

The user-defined withdrawal is treated exactly like the user-defined discharge (described above). The effect of the flow modification on the annual flow-duration curve may be represented either by providing all 15 flow-duration parameters, or by supplying the 4 values of minimal information. If the minimal information option is used, designate whether the maximum withdrawal occurs during wet or dry periods.

Figure 6 (case 2) also illustrates the use of the minimal information option, representing a withdrawal that occurs during the dry portion of the year. Since the monthly minimum is zero, the user is asked to provide the percentage of time (DZERO = 80 percent) for which the withdrawal is not zero. The duration of the average withdrawal rate (DAVG) is situated so that the area under the flow-duration curve is equal to the average rate (QAVG) for the entire period.

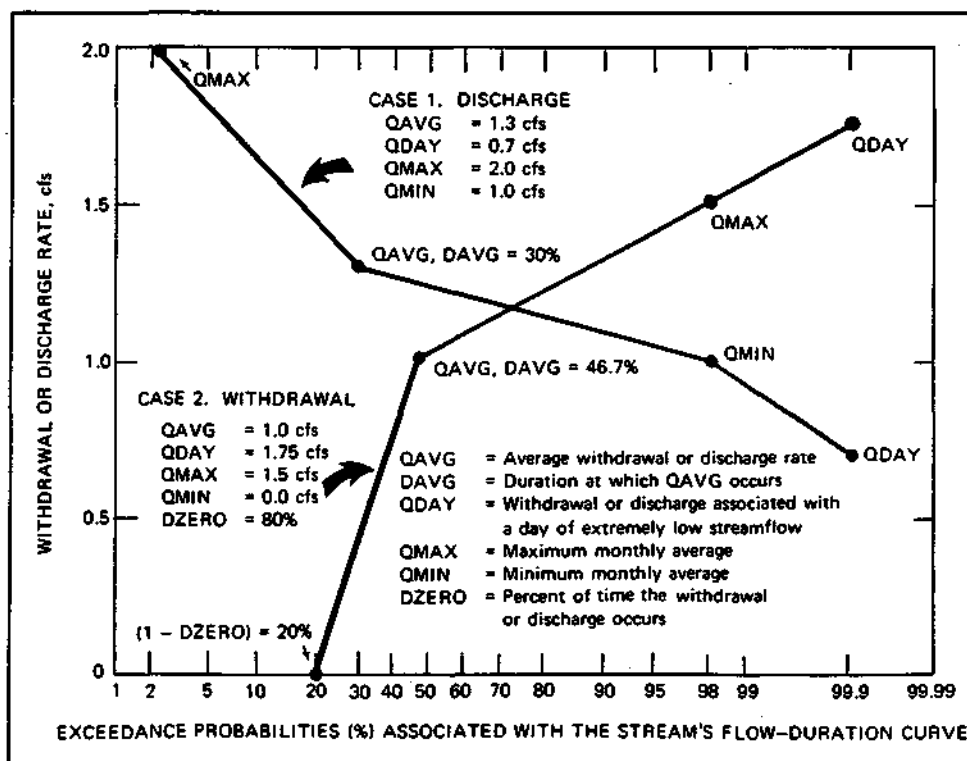


Figure 6. The use of minimal data in describing the flow-duration curve of a user-defined modification (from Knapp et al., 1985, *Streamflow Assessment Model for the Sangamon River Basin in Illinois: User's Manual*, Illinois State Water Survey Contract Report 358)

1.3.8 RESERVOIR

Reservoirs redistribute downstream flows in several ways. First, detention storage acts to attenuate high flows and increase medium flows. Second, the effect of evaporation diminishes low flows. The effect of these first two factors on the annual distribution of flows is illustrated in figure 7. The reservoir will also change the seasonality of flows. Some flow will be retained during high flow periods and be slowly released in the following weeks or months. Also, reservoir drawdown in late summer and fall will extend the season during which low flows occur. ILSAM simulates the redistribution of flows associated with a reservoir that has an uncontrolled outlet, i.e., a free overflow spillway but no other outflow facilities. To estimate the outflow from a potential or hypothetical reservoir, supply two parameters: 1) reservoir surface area and 2) width of the spillway.

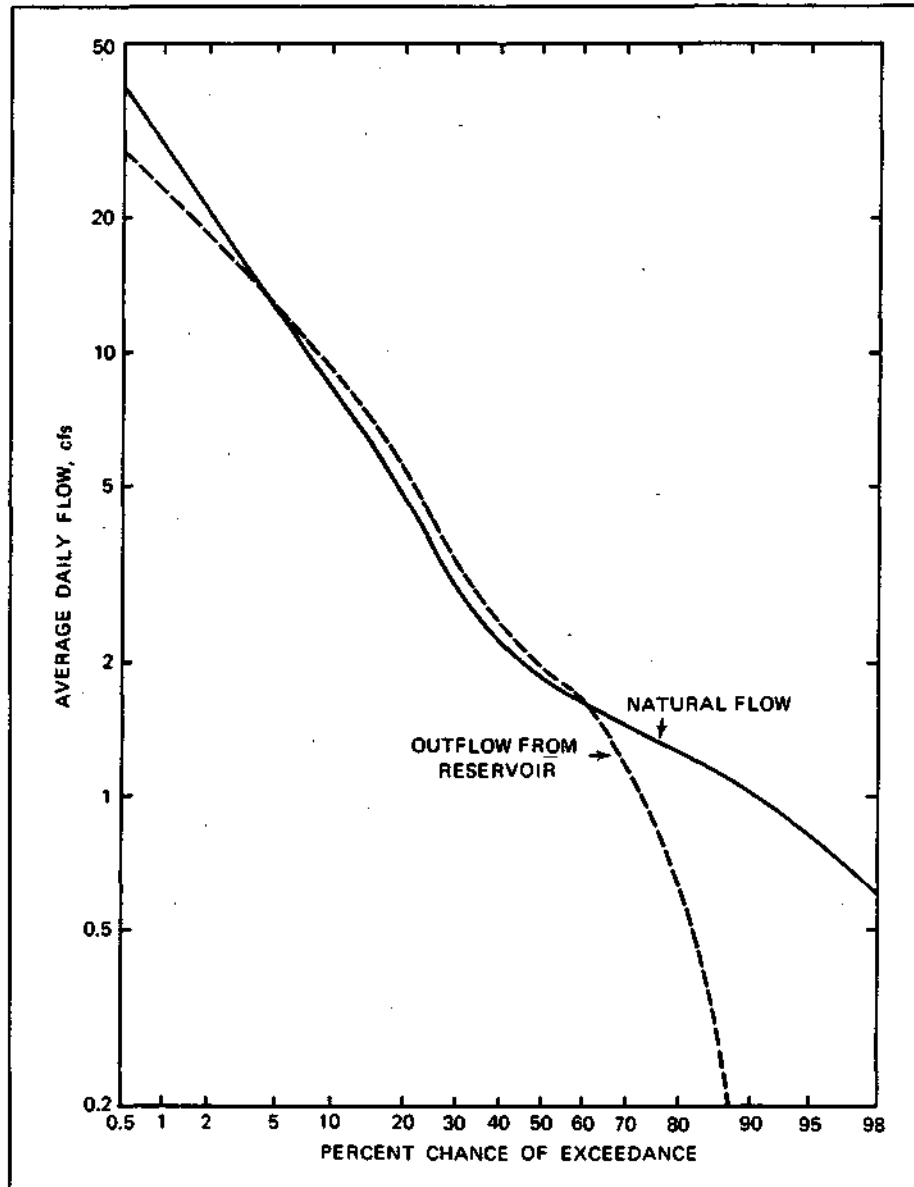


Figure 7. Effects of a reservoir on the annual flow-duration curve

1.3.9 EFFECTS OF FLOW MODIFICATIONS ON ALTERED FLOW DOWNSTREAM

For municipal effluent discharges, uniform discharges and uniform withdrawals, the effect of the modification can usually be directly transposed downstream. For example, if a uniform withdrawal results in an increase in the low flow at the location of the discharge of -3 cfs, then the difference between the present flow and the altered flow further downstream will continue to be -3 cfs. The transposition of the flow modification downstream is illustrated in example 1.

Example 1: Transposed Flows, Withdrawal = 3 cfs

<u>Location</u>	<i>Annual Low Flow</i>		
	<u>Present</u>	<u>Altered</u>	<u>Difference</u>
At point of withdrawal	4	1	(-3)
5 miles downstream	5	2	(-3)
10 miles downstream	7	4	(-3)
15 miles downstream	11	8	(-3)
20 miles downstream	17	14	(-3)

For many streams in Illinois, low flows ordinarily occur in September or October. A seasonal withdrawal, such as an irrigation withdrawal, may cause the lowest flows in the stream to occur at the time of pumping, i.e., in either July or August. However, downstream of the withdrawal, the effect of the natural variation in seasonal flows will eventually become more prominent. In example 2, an irrigation withdrawal causes the lowest streamflow to occur in July, but further downstream the relative effect of the withdrawal diminishes and September becomes the month of lowest flow.

Example 2: Seasonal Changes in Altered Flow, Withdrawal = 5 cfs in July

<u>Location</u>	<i>July Low Flow</i>		<i>September Low Flow</i>		<i>Annual Low Flow</i>		
	<u>Present</u>	<u>Altered</u>	<u>Present</u>	<u>Altered</u>	<u>Present</u>	<u>Altered</u>	<u>Difference</u>
At point of withdrawal	6	1	4	4	4	1	(-3)
5 miles downstream	7.5	2.5	5	5	5	2.5	(-2.5)
10 miles downstream	10	5	7	7	7	5	(-2)
15 miles downstream	16	11	11	11	11	11	(-0)
20 miles downstream	24	19	17	17	17	17	(-0)

If water is discharged to a dry stream, then a portion of that discharged water will either evaporate or infiltrate into the streambed. Thus, the amount of flow in the stream will decrease downstream until the point where the natural flow becomes greater than zero. The effect of dry streams on altered flow downstream of discharges is illustrated in example 3.

Example 3: Dry Stream, Discharge = 3 cfs

<u>Location</u>	<i>Annual Low Flow</i>		
	<u>Present</u>	<u>Altered</u>	<u>Difference</u>
At point of discharge	0.0	3.0	(+3.0)
2 miles downstream	0.0	2.5	(+2.5)
4 miles downstream	0.1	1.6	(+1.5)
8 miles downstream	3.0	4.5	(+1.5)

2. GETTING STARTED

2.1 DIFFERENCES FROM VERSION 3.0

Users familiar with earlier versions of ILSAM should note the following differences:

- In Version 3.2, the ILSAM model is now a group of integrated programs, instead of being a single executable file. The creation of output is handled by one executable file (ILSAM32.EXE), and the viewing and printing of output is handled by two executable files (IPJEXE and IPPLOT.EXE). These three programs are tied together with a controlling batch file (ILSAM.BAT). See section 2.5, Flow of Execution, for more detail.
- In Version 3.0, the user could view the output after each point along the reach was analyzed. In Version 3.2, processing for all points is done before the user can view or print the output.
- Version 32 does not allow multiple runs in a single session.
- The format of the output file created by ILSAM has changed slightly from Version 3.0. For each point analyzed, the stream name and its code is placed in the output file. See section 5.1, Disk Output, for more information.
- The format of the ILSAM.INI file has also changed. In Version 3.2, a new file (ILSAM.BDT) contains basin data. See section 3.1, Configuration Files, for more information.

2.2 SYSTEM REQUIREMENTS

To run ILSAM Version 3.2 you need the following:

- An IBM PC/XT/AT personal computer (PC) with 640 kilobytes (Kb) installed memory
- MS-DOS or PC-DOS 3.0 or greater
- A (CGA, EGA, VGA) graphics adapter or a Hercules-compatible graphics adapter
- One of the following drive configurations:
 - A hard-disk drive with at least one megabyte (Mb) of free space
 - A high-density (5.25" 1.2 Mb or 3.5" 1.44 Mb) floppy-disk drive

Most PCs are now equipped with high-density floppy-disk drives. If you do not have a hard drive or a high-density floppy-disk drive, the Illinois State Water Survey can provide help with setting up a configuration.

2.3 INSTALLING ILSAM

Make sure your computer is on and that the DOS prompt is visible. Consult your DOS manual if you have any questions.

INSTALLING ILSAM TO RUN FROM DISKETTE

If you plan to run ILSAM from diskette, no installation is necessary. You should, however, work from a backup copy; so if you encounter any problems with the diskette, you will still be able to make a fresh copy of ILSAM.

Users who have PCs with high-density drives should have received ILSAM on one diskette (called the Distribution Disk). The program code and initialization files are located in the root directory, and the data for each basin are located in their own subdirectory.

Users having PCs without high-density drives should have received special installation instructions.

INSTALLING ILSAM TO RUN FROM A HARD DRIVE

To install ILSAM on a hard drive, it is necessary to create a directory for ILSAM, and then to copy the files from the diskette or diskettes to the hard drive.

- 1) To create an ILSAM directory on the hard drive (drive C:), type:

MD ILSAM

- 2) To copy the files into the ILSAM directory, place the Distribution Disk in, for example, drive A:, then type:

XCOPY A:*.* C:\ILSAM /s

2.4 OPTIONS FOR SETTING THE DOS ENVIRONMENT

You can modify the way in which ILSAM behaves through the use of a DOS environment variable. To do this, the following DOS statement is used:

```
SET ILSAM=param-1;param-2;...;param-n
```

Each parameter is separated by a semicolon, and can be one of the following values:

- **DELAY:x**
Whenever ILSAM displays a message, execution stops until (depending on the type of message) you press a key or a certain period of time has elapsed. For messages of the latter type, you may specify how long the message is displayed. The default is 1.5 seconds, but you may change it to *x* seconds using this parameter.

Less experienced users may wish to have a longer delay in order to more easily read the messages. More experienced users may prefer a shorter delay or even no delay.
- **MONO**
Use this parameter to run ILSAM on a system equipped with a monochrome or LCD display. ILSAM will map the colors to more easily legible shades of gray.
- **NOSNOW**
Some older CGA adapters will display a flicker or "snow" if the screen is updated while the adapter is updating or "refreshing" the screen. Users who experience this flicker while running ILSAM on a CGA-equipped system should add this parameter. Note, however, that use of the NOSNOW parameter will result in slower screen updates. This parameter does not apply to EGA, VGA, Hercules, and many newer CGA adapters.

Here is an example:

```
SET ILSAM=delay:0.25;mono
```

This forces ILSAM to display its screens in monochrome and to display messages for at least one-quarter of a second.

This command can be typed from the DOS prompt; however, you may wish to add the statement to your AUTOEXEC.BAT file or to the ILSAM.BAT file.

For more information on using DOS environment strings, consult your DOS manual.

2.5 FLOW OF EXECUTION

ILSAM uses three executable files (ILSAM32.EXE, IP.EXE, and IPPLOT.EXE) and a controlling batch file (ILSAM.BAT). Before starting, make sure that you move to the drive and directory that contain these four files.

Start ILSAM by typing:

ILSAM

This runs ILSAM.BAT, which in turn calls ILSAM32.EXE. After ILSAM32.EXE finishes, ILSAM.BAT then calls IP.EXE. IP.EXE allows you to choose the printer to which output is sent, as well as designate which tables and graphs are printed. IP.EXE calls the third executable files, IPPLOT.EXE, which performs the actual printing.

Here is the flow of execution for ILSAM32.EXE:

- 1) Edit the basic parameters if necessary.
- 2) Input the stream information.
 - A) Enter the stream name or code.
 - B) Enter the starting point of the reach.
 - C) Enter the ending point of the reach.
 - D) Enter a flow modification if necessary.
- 3) For each point in the reach:
 - ILSAM calculates the virgin and present flow conditions (and if a flow modification was entered, the altered flow conditions) at the current point for 154 flow parameters. See section 5.1, Disk Output, and Appendix B, Streamflow Parameters and Associated Indexes, for more information.
 - ILSAM writes out information about the point and the flow conditions for each of the 154 flow parameters to a disk file.
- 4) ILSAM32.EXE terminates.

After ILSAM32.EXE has finished, ILSAM.BAT then calls IP.EXE. See section 5.2, Viewing and Printing Output, for a detailed look at IP.EXE.

When IP.EXE finishes, control passes back to ILSAM.BAT which then exits to DOS.

3. INPUT FILES

3.1 CONFIGURATION FILES

Before running ILS AM, it is important to understand the structure of the two initialization files associated with ILSAM32.EXE: ILSAM.INI and ILSAM.BDT.

ILSAM.INI contains the list of basic parameters (run description and output filename) from the previous run. Modification of these parameters is described in section 4.1, Entering the Basic Parameters.

Note: The format of ILSAM.INI is different from previous versions. Installing ILSAM 3.2 should overwrite any old copy, but users who have installed ILSAM to work in the same directory as a previous version should check to make sure they are using the new version of the initialization file.

Here is a sample ILSAM.INI file:

Line	Field Name	Example	Comment
1	Run Description	Basin: Sb	Expands to: "Basin: KASKASKIA"
2	Output Filename	TEST	Output sent to NLSAMKAS\OUTPUT\TEST.DAT

The other initialization file contains data for each of the basins and is called ILSAM.BDT (for Basin DaTa). The file contains the number of basins for which there is information, the index of the basin the user was working on the last time ILSAM was run, and then four pieces of information for each basin:

- The name of the basin
- The file extension for each of the input data files
- The name of the directory in which the input files can be found
- The name of the directory in which the output files are to be written

Here is an example of ILSAM.BDT with data for three basins:

Line	Field	Example	Comment
1	Number of Basins	3	There are three basins.
2	Current Basin	2	The second basin (Kaskaskia) is current.
3	Name #1	Fox	Fox River basin.
4	File Extension #1	FOX	Input files are *.FOX
5	Input Directory #1	C:\ILSAM\FOX	Subdirectory containing Fox input files.
6	Output Directory #1	C:\ILSAM\OUTPUT	Subdirectory to which Fox output is sent.
7	Name #2	Kaskaskia	Kaskaskia River basin.
8	File Extension #2	KAS	Input files are *.KAS
9	Input Directory #2	C:\ILSAM\KAS	Subdirectory containing Kaskaskia input files.
10	Output Directory #2	C:\ILSAM\OUTPUT	Subdirectory to which Kaskaskia output is sent.
11	Name #3	Sangamon	Sangamon River basin.
12	File Extension #3	SAN	Input files are *.SAN
13	Input Directory #3	C:\ILSAM\SAN	Subdirectory containing Sangamon input files.
14	Output Directory #3	C:\ILSAM\OUTPUT	Subdirectory to which Sangamon output is sent.

3.2 DATA FILES

For each basin, eight input data files must be provided. The data contained in these eight files is described below.

ALIAS.EXT

This file contains a list of stream names and their associated stream codes. Not all codes have corresponding names. Some streams are unnamed, and other streams may not be uniquely identified because they share a name with other streams in the watershed. When you ask for a list of available streams while entering the basic parameters, the list consists of the entries in this file.

CNTRLPT.EXT

This file contains the values of the 154 flow parameters of the virgin and present flow at specific sites in the watershed.

COEFF.EXT

This file contains the regional coefficients used to estimate virgin flow of ungaged sites. Three coefficients are given for each of the 154 flow parameters, and up to three different sets of coefficients may be provided.

FLOMOD.EXT

This file contains the flow quantity added to the existing flow in the stream to represent the effect of flow modification. Values are given for each of the major flow modifications in the watershed and for each of the 154 flow parameters.

MODIFY.EXT

When the present flow is computed for a site, ILS AM identifies all flow modifications upstream of that site and computes their composite effect on the location of interest. To eliminate excessive computation for sites affected by numerous flow modifications, the composite effect is sometimes stored in MODIFY.EXT. This file identifies the stream code and river mile of these points, and the location in MODIFY.EXT containing the composite data.

NETWORK.EXT

This file contains watershed information on every stream location in the basin. ILSAM searches this file for such data as a description of the location [for example, *Fox River At Mutton Creek (VV)], average soil permeability, and which coefficients to use in computing virgin flow.

RESERV.EXT

This file contains information for each reservoir in the basin. Each entry lists the location of the reservoir and its surface area, width of the spillway, and average soil permeability for its watershed.

STRNET.EXT

This file describes the network of streams for each basin. There is information for each of the confluences encountered as one moves downstream. Water that originates in the upper parts of the watershed eventually makes its way downstream to the mouth of the watershed by successfully flowing through streams of increasing size. For example, the water in the North Branch Nippersink Creek (code VXN) eventually flows into Nippersink Creek (code VX), which eventually flows into the Fox River (code V). File STRNET.EXT identifies this downstream succession of flow and the river miles at which all tributaries flow into their receiving stream.

4. RUNNING ILSAM

ILSAM uses three executable files (ILSAM32.EXE, IP.EXE, and IPLOT.EXE) and a controlling batch file (ILSAM.BAT). Before starting, make sure that you move to the drive and directory that contain these four files.

Start ILSAM by typing:

ILSAM

When ILSAM begins, an opening screen will display general information about the model as shown in figure 8. It will also describe the use of two keys, which may be used at any time during the run:

- Alt-Q allows you to exit ILSAM at any point during the run
- Alt-? displays the current values for many of the model's parameters

Throughout the running of ILSAM, two windows will be displayed at the bottom of the screen: "Status" and "Commands".

The "Status" window alerts you to the progress of the run, as well as to any error or warning messages. Pay attention to messages appearing in this window.

The "Commands" window describes which keys can be used in the current operation. If you are not sure of what action to take next, this window will provide directions.

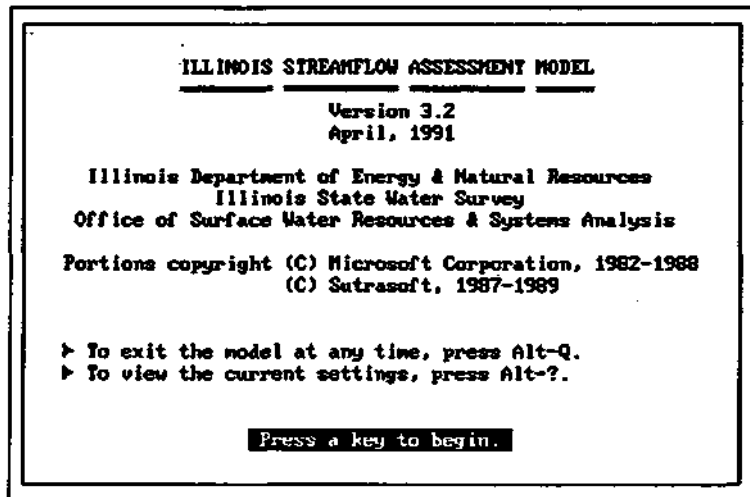


Figure 8. ILSAM's opening screen

4.1 ENTERING THE BASIC PARAMETERS

After ILS AM's opening screen, a list of the basic parameters is presented, as shown in figure 9. All of the fields have defaults, so you need only change those fields that require different values.

Edit Basic Parameters Run Description: \$b BASIN Output Filename: TEST .DAT — BASIN — Name: Fox Dataset File Extension: FOX Input Dir: C:\ILSAM\DATA\FOX Output Dir: C:\ILSAM\DATA\FOX		
Status Selecting basic parameter.		
Commands t:Move among fields Space:Edit Esc:Done		

Figure 9. Entering the basic parameters

Use the T and i keys to scroll through the fields. Or press the highlighted letter of the field label to select it.

To edit a field, press the SPACEBAR. To accept the changes, press ENTER; to discard them, press Esc.

Once the values are correct, press Esc to exit the menu. The values will automatically be saved and used the next time ILSAM is run.

The six basic parameters are discussed in detail below.

4.1.1 RUN DESCRIPTION

The run description, located at the top of all output, is an arbitrary phrase or name used to distinguish output from different runs. To help automate the process, the description may contain one or more of the provided "macros." A macro is a combination of characters that represent one or more words. In the case of ILSAM, a macro is represented by a dollar sign followed by an additional character.

The provided macros are listed below:

Macro	Description
\$b	The current basin name.
\$d	The date the run was completed.
\$f	The base of the output filename.
\$i	The input directory.
\$o	The output directory
\$t	The time of day the run was completed.
\$\$	The dollar sign itself.

For example, a run description of
\$b basin: \$d at \$t

would be transformed into

Kaskaskia basin: 06-11-91 at 12:34:00

meaning that this run was performed on the Kaskaskia basin and was completed at 12:34 p.m. on June 11, 1991.

4.1.2 OUTPUT FILENAME

This field identifies the base of the output filename; that is, the filename without the extension, which is fixed as .DAT.

For example, if the output filename is given as:

TEST

then output would be written to the file:

TEST.DAT

The name you provide becomes the base of the filename, and must contain between one and eight legal DOS characters. Consult your DOS manual for information about filenames.

4.1.3 BASIN NAME

This field identifies the name of the basin containing the desired reach. Use the and keys to scroll among legal basins. Please note, however, that this is the list of basins given in the ELSAM.BDT file and may not necessarily reflect the list of basins for which data is provided.

4.1.4 DATASET FILE EXTENSION

This field identifies the filename extension of all the input files for the current basin. At present there are four standard filename extensions, representing the four watersheds for which ILSAM has been developed:

<u>Watershed</u>	<u>Filename Extension</u>
Fox	.FOX
Kankakee	.KAN
Kaskaskia	.KAS
Sangamon	.SAN

Additional filename extensions will be added as ILSAM is developed for more watersheds.

Users of the model, if they choose to modify datasets, may want to develop alternative filename extensions for these new datasets. The filename extensions should be three legal DOS characters. Consult your DOS manual for additional information about filenames.

4.1.5 INPUT DIRECTORY

This field identifies the directory that holds the input data files for the current basin.

4.1.6 OUTPUT DIRECTORY

This field identifies the directory that will hold output files created by ILSAM for the current basin.

An output file is created for each run. The name of the output file is determined by the output directory and the output filename.

For example, if you enter

C:\ILSAM\FOX\OUTPUT

as the output directory for the Fox basin, and enter

TEST

as the output filename, then output would be sent to the file called:

C:\ILSAM\FOX\OUTPUT\TEST.DAT

4.2 ENTERING THE STREAM REACH INFORMATION

The next set of parameters to be entered describes the stream reach to be analyzed. While the basic parameters will not generally be changed for every run, the stream reach information must be entered each time ILSAM is executed.

First, identify the stream containing the starting point of the reach. Then enter the starting point of the reach, and finally select the ending point of the reach.

4.2.1 STREAM NAME

The menu used to select the stream name is shown in figure 10.

Every stream in a basin is assigned a unique stream code. ILSAM requires this code to identify the stream containing the starting point. The code may be provided in one of three ways:

- Type the code directly.
- Type the name of the stream.
- Press PGDN to obtain a list of streams from which to choose.

Input Stream Type the name or code of the stream to be analyzed. Stream: Fox River
Status Choosing from the list of streams.
Commands PgDn:Streams menu

Figure 10. Entering the stream name or code

Typing the code directly is the fastest method, but to do this you must either memorize the code associated with that particular stream or look up the code using the supplemental information provided for each river basin.

Entering the stream name can be efficient if the name is short and you use the same spelling given in the alias file.

But the easiest method is to type PGDN. A menu like that shown in figure 11 will appear containing a list of all the streams located in the alias file along with their associated codes. As shown in the "Commands" window in figure 11, the , , PGUP, and PGDN keys are used to scroll among the listed streams. Press ENTER to choose the highlighted stream.

A few streams are not listed in the alias file (they are unnamed or have the same name as another stream). These few streams must be identified by their codes only.

Input Stream Type the name or code of the stream to be analyzed. Stream:															
List of Streams <table border="1"> <tr><td>Battle Creek</td><td>UHMO</td></tr> <tr><td>Big Rock Creek</td><td>UH</td></tr> <tr><td>Blackberry Creek</td><td>UI</td></tr> <tr><td>Boone Creek</td><td>UW</td></tr> <tr><td>Breuster Creek</td><td>UO</td></tr> <tr><td>Brunbach Creek</td><td>UD</td></tr> <tr><td>Buck Branch</td><td>UFX</td></tr> </table>		Battle Creek	UHMO	Big Rock Creek	UH	Blackberry Creek	UI	Boone Creek	UW	Breuster Creek	UO	Brunbach Creek	UD	Buck Branch	UFX
Battle Creek	UHMO														
Big Rock Creek	UH														
Blackberry Creek	UI														
Boone Creek	UW														
Breuster Creek	UO														
Brunbach Creek	UD														
Buck Branch	UFX														
Status Choosing from the list of streams.															
Commands <table> <tr> <td>PgUp:Prev page</td> <td>Home:First page</td> </tr> <tr> <td>PgDn:Next page</td> <td>End:First page</td> </tr> <tr> <td>Enter:Accept stream</td> <td>+j:Move among streams</td> </tr> </table>		PgUp:Prev page	Home:First page	PgDn:Next page	End:First page	Enter:Accept stream	+j:Move among streams								
PgUp:Prev page	Home:First page														
PgDn:Next page	End:First page														
Enter:Accept stream	+j:Move among streams														

Figure 11. Choosing from the List of Streams

4.2.2 STARTING POINT

After a stream is selected, a list of the points along the stream are presented, as shown in figure 12. Each entry in the menu contains the stream code, the mileage along that stream, and possibly a description of that point.

Again, the , , PGUP, and PGDN keys are used to scroll through the points listed in the "Commands" window of figure 12. Press ENTER to choose the highlighted location.

Or press the INS key to insert a starting point not among those listed. You will be prompted to enter the desired river mile.

4.2.3 ENDING POINT

Finally, select the ending point of the reach. The menu has the same format as the starting point menu and consists of all points between the starting point and the mouth of the major river of the basin.

The ending point is selected in the same manner as the starting point, except an unlisted mileage may not be inserted.

Choose Starting Point		
UH	30.28	
UH	26.98	Harter Road
UH	25.78	Perry Road
UH	24.18	Owens Road
UH	21.71	
UH	21.78	at Youngs Creek (UHT)
UH	19.88	Kane-DeKalb County Line
UH	15.78	US HWY 638
UH	13.81	
UH	13.88	at West Branch Big Rock Creek (UHM)
UH	12.98	Price Road
UH	10.31	
UH	10.38	at Welch Creek (UHL)

Status
Choose a starting point on UH.

Commands		
+↑: Move among points	PgUp: Goto prev page	Home: Goto first point
Enter: Select point	PgDn: Goto next page	End: Goto last point
Ins: Enter unlisted mile		

Figure 12. Entering the starting point of the reach

4.3 ENTERING A FLOW MODIFICATION

The last type of information to be entered before the analysis can begin is an optional hypothetical flow modification. There are eight different kinds of flow modifications from which to choose. Section 1.3, Flow Modifications, provides some guidelines for under which conditions a type of modification is appropriate.

4.3.1 MUNICIPAL EFFLUENT DISCHARGE

Figure 13 shows the input screen used to enter a municipal effluent discharge. First, input the average daily discharge and press ENTER. Then enter the minimum daily discharge. A value will be provided that is 80 percent of the average daily discharge. If this value is acceptable, press ENTER. If not, type in a new value.

Municipal Effluent Discharge	
Enter the average daily discharge in cfs:	16
Enter the minimum monthly discharge in cfs:	12.8

Status
Enter the minimum flow (default is 80% of the average)

Commands
Enter: Accept value

Figure 13. Entering a municipal effluent discharge

4.3.2 UNIFORM DISCHARGE

Figure 14 shows the input screen used to enter a uniform discharge. Simply type in the discharge and press ENTER.

Uniform Discharge Enter the discharge in cfs: 18	
Status Entering a uniform discharge.	
Commands Enter:Accept value	

Figure 14. Entering a uniform discharge

4.3.3 UNIFORM WITHDRAWAL

Figure 15 shows the input screen used to enter a uniform withdrawal. First, input the withdrawal rate. You will then be asked if there is a minimum flow level below which the withdrawal ceases. If so, press Y, and then enter the minimum flow. If not, press N.

Uniform Withdrawal Enter the withdrawal in cfs: 22 Is there a flow below which the withdrawal ceases? Yes Enter the minimum flow in cfs (blank = 0): 4	
Status Entering a uniform withdrawal	
Commands Enter:Accept value	

Figure 15. Entering a uniform withdrawal

4.3.4 SEASONAL DISCHARGE

Figure 16 shows the input screen used to enter a seasonal discharge. Enter a discharge rate for each month of the year.

Seasonal Discharge		Month Discharge	
Jan	18	Jul	
Feb	16	Aug	
Mar	28	Sep	
Apr	35	Oct	
May		Nov	
Jun		Dec	

Status	Entering seasonal discharge data.
--------	-----------------------------------

Commands	Enter:Accept value
----------	--------------------

Figure 16. Entering a seasonal discharge

4.3.5 SEASONAL WITHDRAWAL

Figure 17 shows the input screen used to enter a seasonal withdrawal. Enter a withdrawal rate for each month of the year, as well as the minimum streamflow for each month, below which the withdrawal will cease.

Seasonal Withdrawal			Month Withdrawal Q-min		
Jan	6	8	Jul		
Feb	5	8	Aug		
Mar	12	6	Sep		
Apr	16	9	Oct		
May			Nov		
Jun			Dec		

Status	Entering seasonal withdrawal data.
--------	------------------------------------

Commands	Enter:Accept value
----------	--------------------

Figure 17. Entering a seasonal withdrawal

4.3.6 USER-DEFINED DISCHARGE

The user-defined discharge and user-defined withdrawal are basically the same flow modifications that were provided in previous versions of ILSAM.

There are two methods for entering a user-defined discharge: either input discharge rates associated with each of the annual flow-duration parameters, or simply enter a few pieces of information from which the discharge rates for each parameter will be extrapolated.

The option to enter discharge rates (flow modification curve) for all annual flow-duration parameters is shown in figure 18. Type in the flows for each of the exceedance probabilities.

Flow Modification Curve

Q1:	85	Q60:
Q2:	60	Q75:
Q5:	52	Q85:
Q10: 44		Q90:
Q15:		Q95:
Q25:		Q98:
Q40:		Q99:
Q50:		Qaug:

Status

Entering entire flow modification curve.

Commands

Enter:Accept value

Figure 18. Entering user-defined discharge rates (flow modification curve) for all the annual flow-duration parameters

If only minimal information is to be entered, you will be presented with a screen like that in figure 19. First, you will be asked whether the maximum discharge occurs during wet periods. Respond yes (Y) or no (N). Then enter values for the average and minimum (or maximum) daily discharges and both the minimum and maximum monthly discharge rates.

Minimal Information	
Do you wish to input the entire flow modification curve? No	
Will the maximum discharge occur during wet periods? Yes	
Enter the average daily discharge in cfs:	6
Enter the minimum daily discharge in cfs:	3.6
Enter the maximum monthly discharge in cfs:	9
Enter the minimum monthly discharge in cfs:	4.8
Status	
Entering minimal information.	
Commands	
Enter:Accept value	

Figure 19. Entering the user-defined discharge using minimal information

4.3.7 USER-DEFINED WITHDRAWAL

A user-defined withdrawal may be input the same way as a user-defined discharge, by either specifying withdrawal rates for each of the annual flow-duration parameters or by entering only minimal information.

Entering the entire curve is shown in figure 20.

Flow Modification Curve	
Q1: 10	Q60:
Q2: 10	Q75:
Q5: 10	Q85:
Q10: 10	Q90:
Q15: 5	Q95:
Q25: 5	Q98:
Q40:	Q99:
Q50:	Qavg:
Status	
Entering entire flow modification curve.	
Commands	
Enter:Accept value	

Figure 20. Entering user-defined withdrawal rates (flow modification curve) for all the annual flow-duration parameters

If only minimal information is to be entered, you will be presented with a screen like that in figure 21. First, you will be asked whether the maximum withdrawal occurs during dry periods. Respond yes (Y) or no (N). Then enter values for the average and maximum (or minimum) daily withdrawals and both the minimum and maximum monthly withdrawal rates.

Minimal Information	
Do you wish to input the entire flow modification curve? No	
Will the maximum withdrawal occur during dry periods? Yes	
Enter the average daily withdrawal in cfs:	7
Enter the minimum daily withdrawal in cfs:	0
Enter the maximum monthly withdrawal in cfs:	7
Enter the minimum monthly withdrawal in cfs:	0
What percentage of the time does the withdrawal occur?	30
Status	
Entering minimal information.	
Commands	
Enter:Accept value	

Figure 21. Entering the user-defined withdrawal using minimal information

4.3.8 RESERVOIR

Figure 22 shows the input screen used to enter a reservoir. Two pieces of information are needed: the area of the reservoir in square miles and the width of the spillway in feet

Reservoir	
Enter the area of the reservoir in square miles:	3.5
Enter the width of the spillway in feet:	30
Status	
Entering a flow modification.	
Commands	

Figure 22. Entering a reservoir

5. OUTPUT

5.1 DISK OUTPUT

For each run, ILSAM creates an output file. The filename is determined by the output directory and output filename for the given basin as described in sections 4.1.2, Output Filename, and 4.1.6, Output Directory.

The file contains information pertaining to the entire run followed by information for each point analyzed. Here is the structure of the output file:

Run info	Run Description
Data for point 1	Stream Code 1 Stream Name 1 Mile, Miles Left, Drainage Area, Point Description V_1 P_1 $[A_1]$ V_2 P_2 $[A_2]$ V_3 P_3 $[A_3]$ V_{154} P_{154} $[A_{154}]$
Data for point 2	Stream Code 2 Stream Name 2 Mile, Miles Left, Drainage Area, Point Description V_1 P_1 $[A_1]$ V_2 P_2 $[A_2]$ V_3 P_3 $[A_3]$ V_{154} P_{154} $[A_{154}]$
Data for remaining points	Same format as above

The Run Description is the one entered in the Basic Parameters menu.

The Stream Code is the unique code assigned to every stream. The Stream Name is the associated name as found in the alias file (if available).

The Mile is the mileage of the point along the current stream. The Miles Left is the mileage remaining to be analyzed. And the Drainage Area is the drainage area for the given point.

There are three types of flow output values:

- Virgin Flow - The estimated flow at the same stream location if the influence of the flow modifications were removed. V_n represents the virgin flow for flow parameter n .
- Present Flow - The estimated flow at the stream location given current conditions. P_n represents the present flow for flow parameter n .
- Altered Flow - The estimated flow at the same stream location if the user-input flow modification was implemented. A_n represents the altered flow for flow parameter n .

There are 154 flow parameters modeled by ILSAM. For a complete description, see appendix B, Streamflow Parameters with Associated Indexes.

Here is a sample output file:

Fox BASIN		
V		
Fox River		
104.51,	10.60,	1201.00
Fox River Regional sanitary discharge		
3437	3524	3479
2814	2689	2644
2097	2173	2128
...
154	188	143
119	142	97.0
519	561	516

5.2 VIEWING AND PRINTING OUTPUT

While the function of ILSAM32.EXE is to produce disk output, the job of IP.EXE is to allow the viewing and printing of that output. When ILSAM32.EXE has completed the **run**, ILSAM.BAT calls IP.EXE. Since IP is a stand-alone program, it can be run from DOS to view and print the output from previous runs of the model.

5.2.1 FLOW OF EXECUTION

The flow of execution for IP is as follows:

- 1) Select the printer and output port.
- 2) Select the output datafile.
- 3) Select the "style" to apply.
- 4) Apply the style to a list of points.
- 5) View or print all the tables and graphs in the current style for all points selected.
- 6) Repeat steps 1-5.

5.2.2 D? MENU

PRINTER

The Printer menu is used to select the device used to view the output. The destination may be the screen — to view the output — a printer or a plotter.

There are two menu items in the PRINTER menu: DEVICE and PORT. Use DEVICE to select the device used for viewing or printing as shown in figure 23. Use the **↑** and **↓** keys to move among the devices, and press ENTER to select one. The available devices are listed as follows:

- Screen (CGA, EGA, VGA, or Hercules adapters supported)
- Epson dot-matrix, draft quality
- Epson dot-matrix, letter quality
- IBM Proprinter dot-matrix, draft quality
- IBM Proprinter dot-matrix, letter quality
- Okidata dot-matrix, draft quality
- Okidata dot-matrix, letter quality
- Hewlett-Packard LaserJet, 75 d.p.i.
- Hewlett-Packard LaserJet, 100 d.p.i.
- HPGL (Hewlett-Packard plotters)
- DM/PL (Houston Instruments plotters)

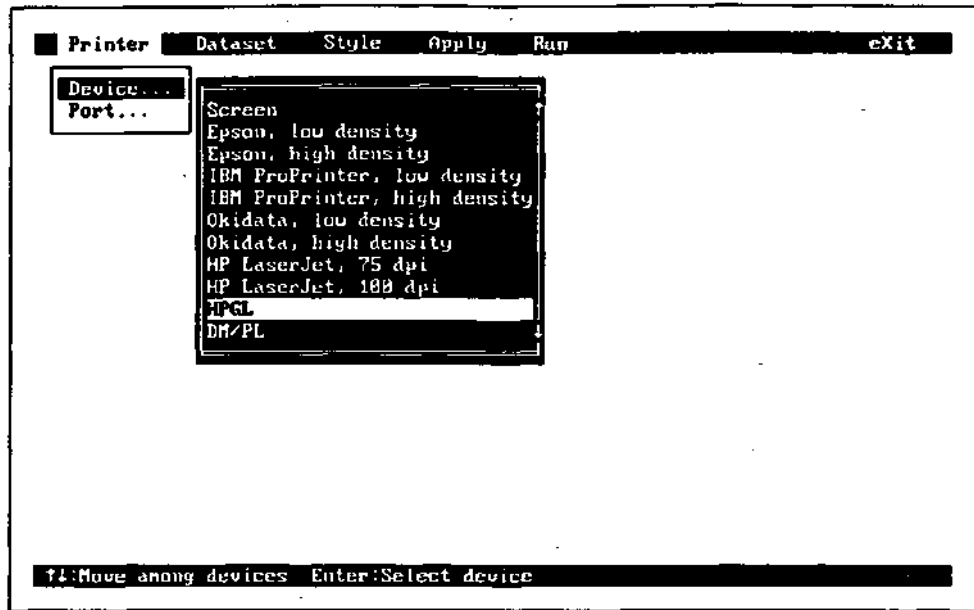


Figure 23. Choosing the output device

If the device is a printer or a plotter, then use PORT to select where the output should be sent, as shown in figure 24. Depending on the device, and how it is connected to your computer, the output could be sent to either a COM port or an LPT port. Output can also be printed directly to disk files. Use the **↑** and **↓** keys to scroll among the list of ports, and press **ENTER** to choose one.



Figure 24. Choosing the output port

DATASET

After selecting the output device and port, choose the name of the file containing output created by ILSAM. Selecting the DATASET menu brings up an edit box that can be used to enter the name of the output file. If IP has been called after the execution of ILSAM32.EXE, the output filename from that run will automatically be listed; simply press enter to select it. To view a different output file, simply enter the name of that file. To select from a list of available files, enter a file specification; for example, by specifying *.DAT as shown in figure 25.

STYLE

After the dataset has been chosen, choose the list of tables and graphs you wish to view or print.

Microsoft Word users may be familiar with the term "style", a set of formatting characteristics that can be applied to a character, paragraph, or to the whole document. IP uses a similar definition for style — a set of tables and graphs that can be applied to a list of output points. For example, to view only the monthly flow-duration tables for June, July, and August, a style may be defined, say "Summer Flow-Durations" that may be applied to the stream locations just analyzed by ILSAM. IP remembers your list of styles from one run to the next, which makes it easy to look at selected set of output over the course of many runs.

Selecting the STYLE menu brings up the display shown in figure 26. There are four items in the menu: SELECT A STYLE TO APPLY, MODIFY A STYLE, CREATE A NEW STYLE, and DELETE A STYLE.

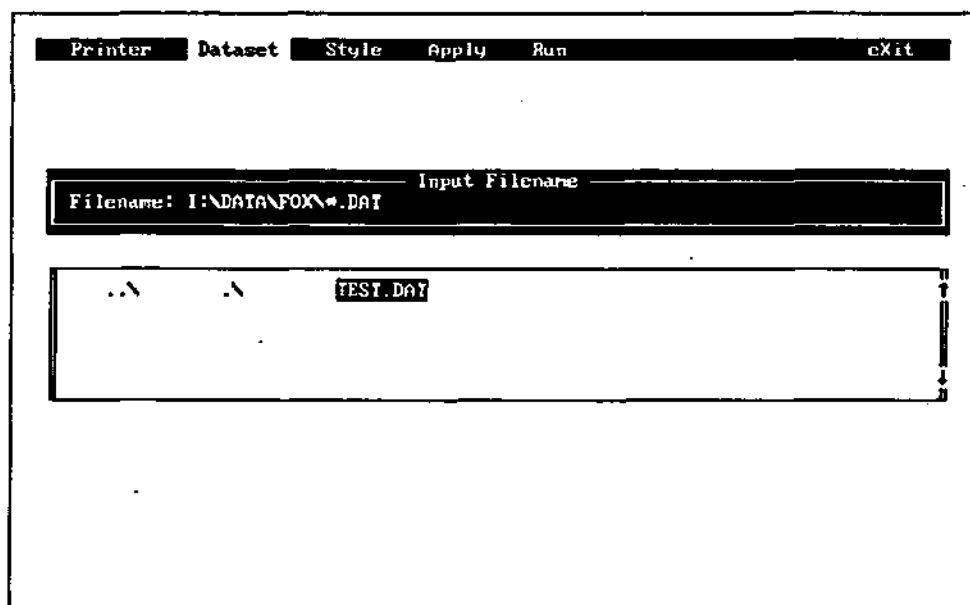


Figure 25. Choosing the dataset

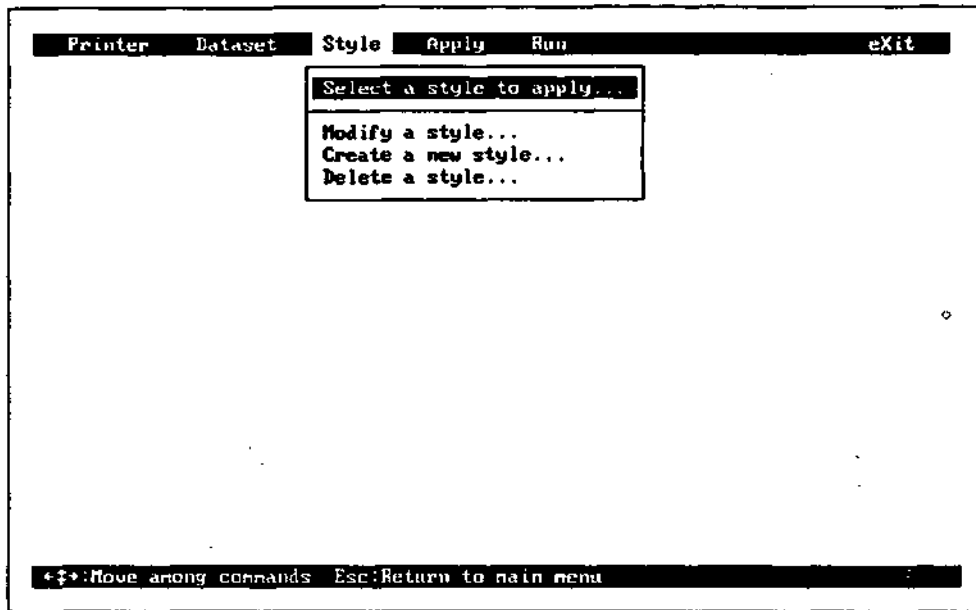


Figure 26. The STYLE menu

An existing style is used by selecting the item **SELECT A STYLE TO APPLY**. A list of available styles will be presented from which to choose, as shown in figure 27. Use the T and I keys to scroll among the list of styles, and press ENTER to choose the highlighted style.

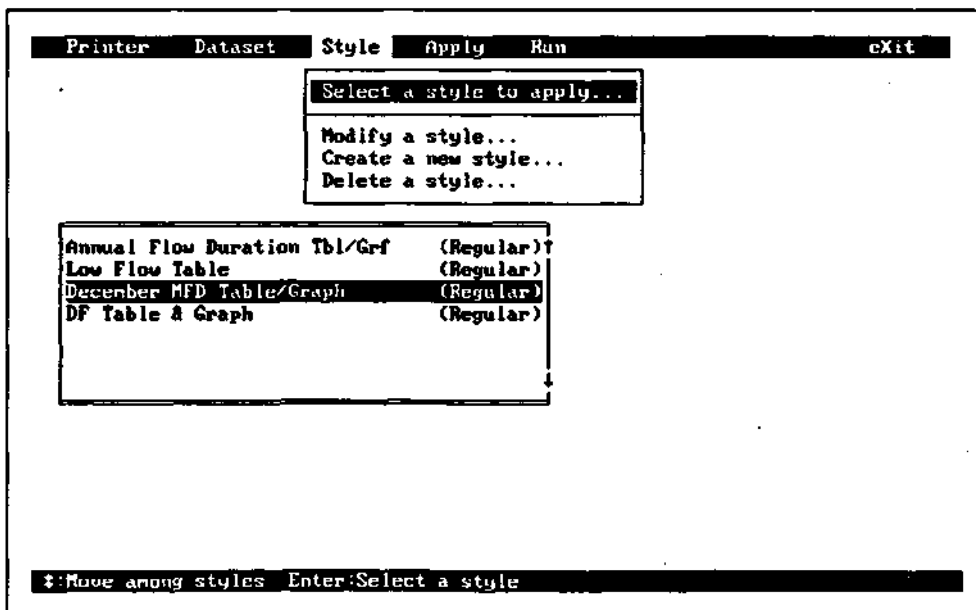


Figure 27. Selecting from the list of available styles

The output set for a particular style may be modified by choosing MODIFY A STYLE. After selecting the desired style, a list of flow categories will be presented, as shown in figure 28. For each table or graph you wish to be a part of the style, select its flow category and then choose that table or graph. For example, to make a "Summer Row Tables" style, choose the "Monthly flow durations" style and then select the tables for June, July, and August. A style can be comprised of any set of tables and graphs from any number of the flow categories.

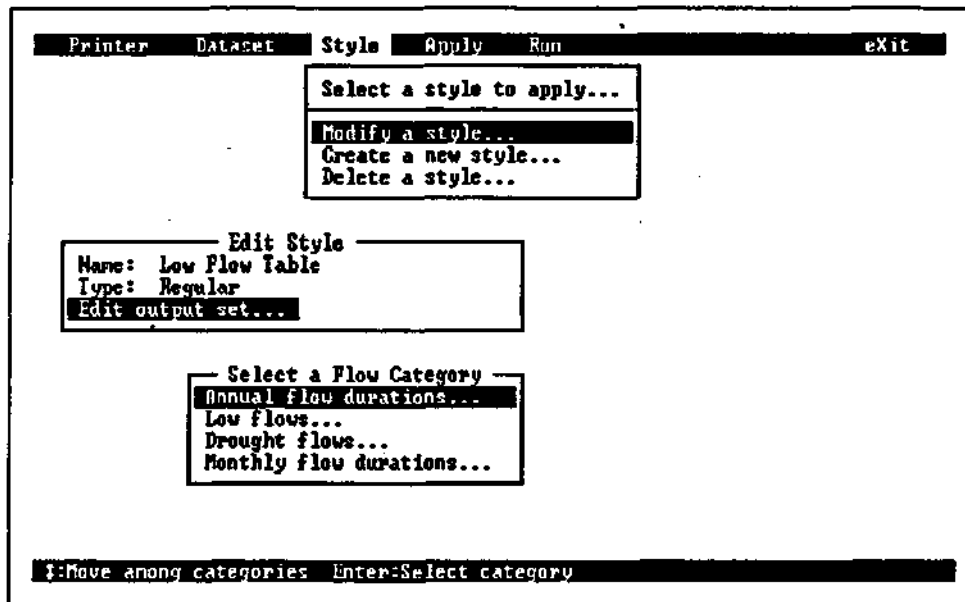


Figure 28. Selecting a flow category

To modify the list of annual flow durations, select that flow category as shown in figure 29. Use `↑` and `↓` keys to move to the table or graph entry. Pressing `ENTER` toggles the entry as selected or unselected. If the entry is selected, there will be right quillemts (») to the left of the entry. After selecting an entry, press `Esc`.

To modify the set of low flow tables and graphs, choose that flow category, and select entries as shown in figure 30. An example of modifying the list of drought flows is shown in figure 31. An example of modifying the list of monthly flow durations is shown in figure 32.

To create a new style, choose the `CREATE A NEW STYLE` menu item. An `EDIT STYLE` window, like that shown in figure 33, will appear. Two pieces of information are needed: the name of the style and the output set. A third piece of information is the style type; which for the current version of ILS AM must be "regular".

To edit the style name, press `ENTER` and type in the new name (replacing "«new style»"), and press `ENTER` again. Then scroll down to "Edit output set" and press `ENTER`. Apply the same technique used to modify a style to define the new output set.

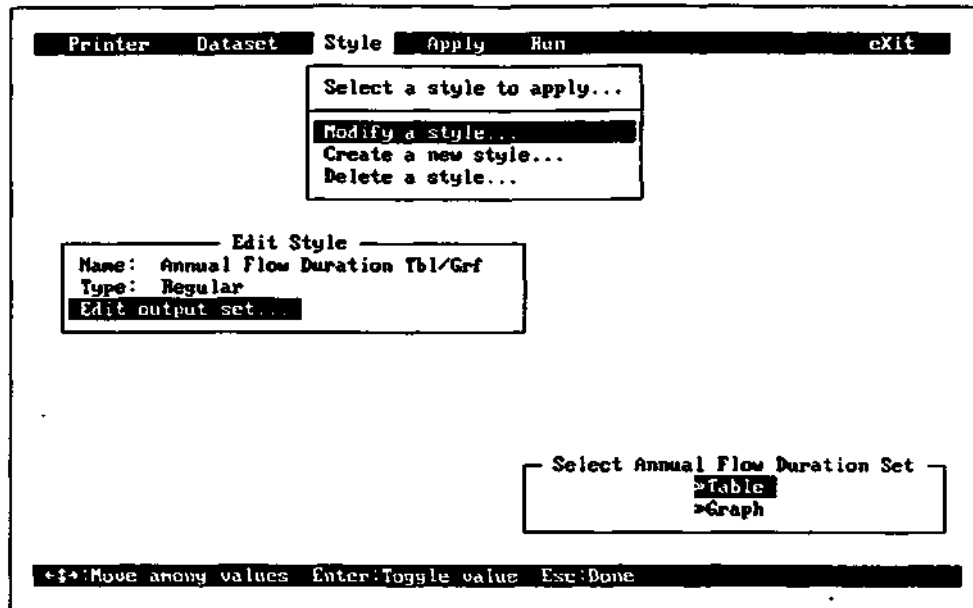


Figure 29. Modifying the list of annual flow-duration tables and graphs

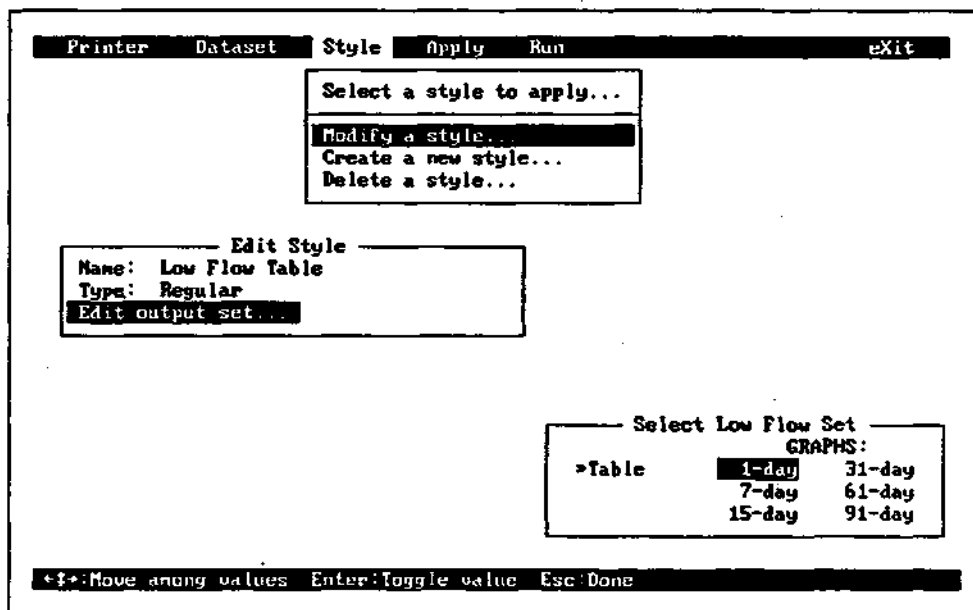


Figure 30. Modifying the list of low flow tables and graphs

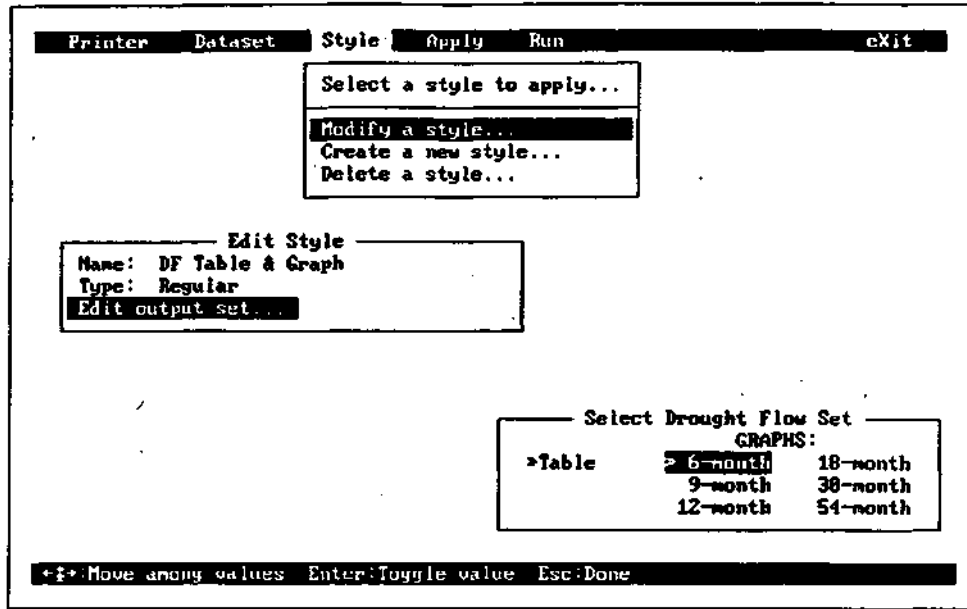


Figure 31. Modifying the list of drought flow tables and graphs

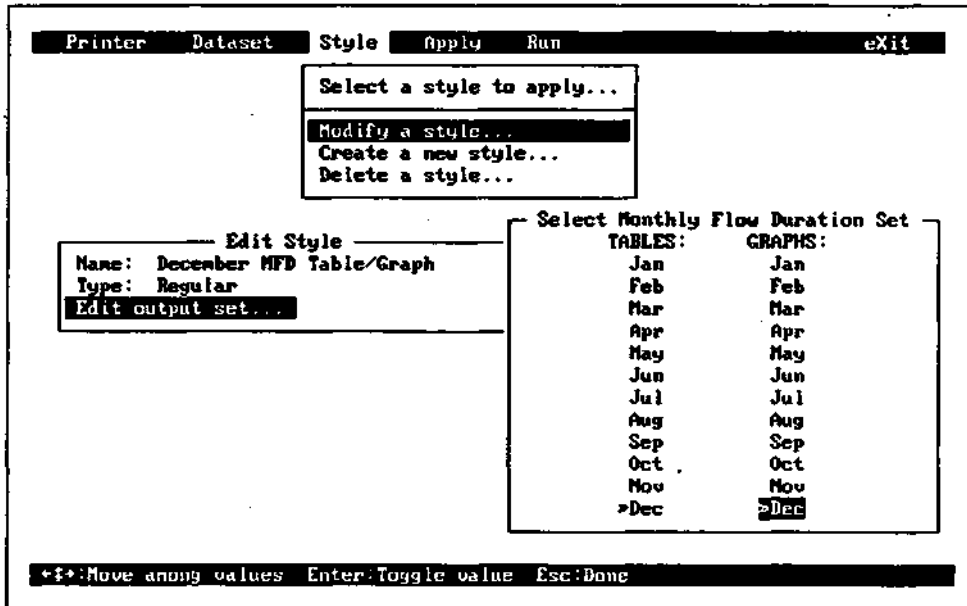


Figure 32. Modifying the list of monthly flow-duration tables and graphs

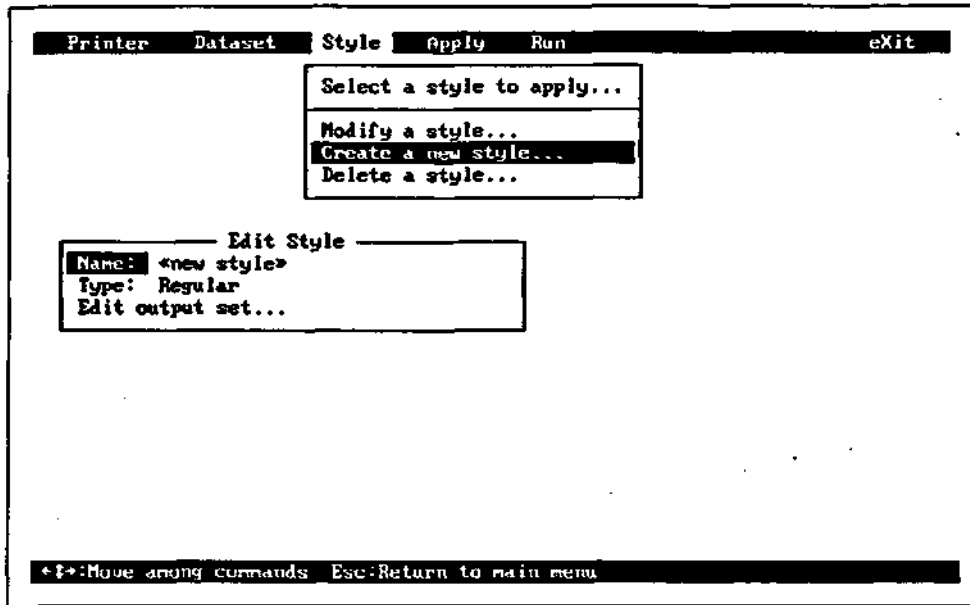


Figure 33. Creating a new style

APPLY

Once a style is selected, it must be applied to a set of output points. Choosing APPLY brings up a list of all stream locations in the output file as shown in figure 34. Use the T and i keys to scroll among the entries. Pressing ENTER toggles the entry as selected or unselected. If the entry is selected, there will be right quillemts (») to the left of the entry. After selecting the desired locations, press Esc

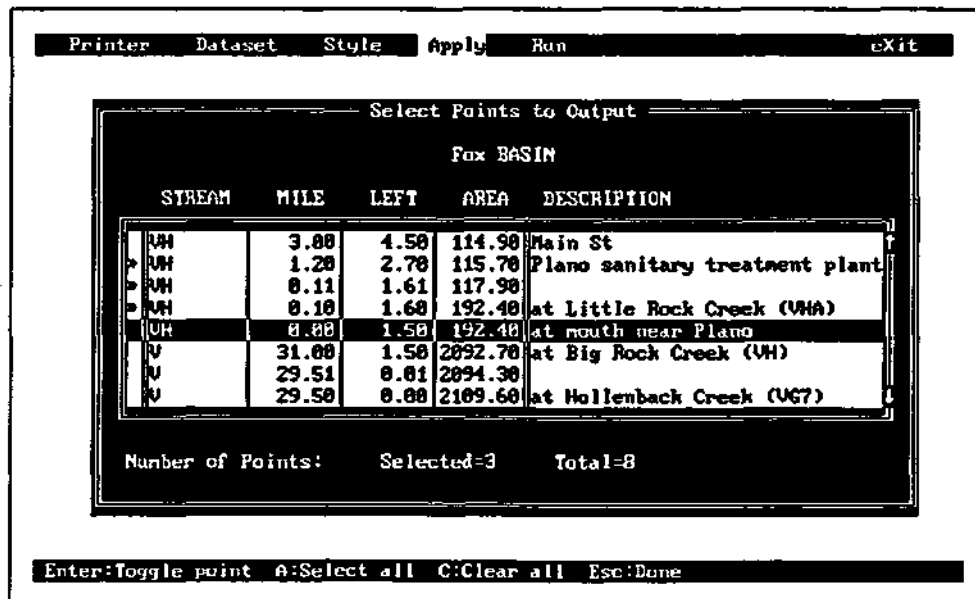


Figure 34. Applying the selected style to a set of output points

RUN

Selecting the RUN menu starts the actual printing process. For each stream location selected with the APPLY menu, IP displays or prints all of the tables and graphs in the current style.

See section 5.3, Sample Output, for samples of the output created when the RUN menu is selected.

All tables and graphs have the same layout regardless of the device on which they are created with one exception: due to the low resolution of its graphics screens, output on CGA adapters will contain only the stream code of the current point and not the point description.

EXIT

After RUN is completed, you may return to any of the PRINTER, DATASET, STYLE, or APPLY menus to make any changes for a future run. After choosing a new set of parameters, choose RUN again to view or print the output. After all the runs are completed, select EXIT to exit IP and ILSAM.

5.3 SAMPLE OUTPUT

This section contains sample output for each of the possible table and graph types. There is a table and a graph for each of the flow categories:

- Annual Flow Durations
- Low Flows
- Drought Flows
- Monthly Flow Durations

The following information is provided at the top of each piece of sample output:

- Flow category and output type (table or graph)
- Run description
- Stream name and code
- Mile of the current point on the current stream
- Mileage remaining to be analyzed
- Drainage area upstream of the current point

The parameters for each of the output types were discussed in section 1.1, Streamflow Parameters Estimated in ILSAM.

Figure 35 shows a sample annual flow-duration table. The virgin and present flow conditions are listed for each of the annual flow-duration exceedance probabilities. If a flow modification was input, the altered flow conditions at the current point are also listed.

Figure 36 shows a sample annual flow-duration graph. The graph plots flow (in cubic feet per second) versus exceedance probability for the virgin and present flows (and if a flow modification was input, altered flow). The average flow values are displayed as horizontal lines extending from Q_{98} to Q_1 .

Figure 37 shows a sample low flow table. The table displays the virgin and present flows (and if a flow modification was input, altered flow) for each of the low flow durations and recurrences.

Figure 38 shows a sample low flow graph. Each graph plots the virgin and present flows (and if a flow modification was input, altered flow) versus the low flow recurrences for a given low flow duration.

Figure 39 shows a sample drought flow table. The table displays the virgin and present flows (and if a flow modification was input, altered flow) for each of the drought flow durations and recurrences.

Figure 40 shows a sample drought flow graph. Each graph plots the virgin and present flows (and if a flow modification was input, altered flow) versus drought recurrence for a given drought duration.

Figure 41 shows a sample monthly flow-duration table for January. There is a table for each of the twelve months. Listed are the virgin and present (and if a flow modification was input, altered flow) for each of the monthly flow-duration exceedance probabilities.

Figure 42 shows a sample monthly flow-duration graph for January. The graph plots flow versus exceedance probability for the virgin and present flows (and if a flow modification was input, altered flow) for the selected month. The average flow values are displayed as horizontal lines extending from Q_{98} to Q_1 .

ANNUAL FLOW DURATION		FOX BASIN			
Stream: Fox River (U)					
Mile: 104.51 (Fox River Regional sanitary discharge)					
To-Co: 0.0					
da: 1201.0					
	Exc. Prob.	Virgin	Present	Altered	
	01	3437	3524	3479	
	02	2814	2889	2844	
	05	2097	2173	2128	
	010	1622	1698	1653	
	015	1365	1430	1385	
	025	914	968	923	
	040	599	643	598	
	050	452	490	445	
	060	349	384	339	
	075	234	264	219	
	085	177	206	161	
	090	150	178	133	
	095	118	142	96.6	
	098	96.1	110	73.5	
	099	83.7	103	58.1	
	Qavg	703	745	700	

Figure 35. A sample annual flow-duration table

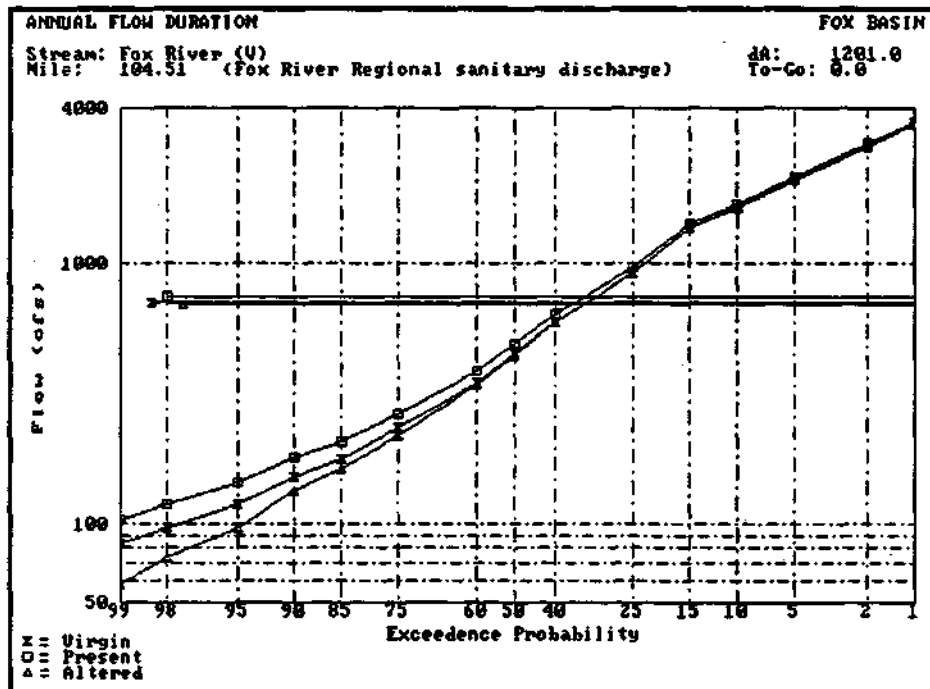


Figure 36. A sample annual flow-duration graph

LOW FLOWS

FOX BASIN

Stream: Fox River (U)

Mile: 104.51 (Fox River Regional sanitary discharge)

To-Go: 0.0

dA: 1201.0

Recurrence (years)

Duration (days)

1

2

10

25

50

X

□

△

7

15

31

61

91

125

147

102

132

157

112

143

170

125

157

184

139

175

205

160

214

244

199

79.3

85.3

57.5

82.1

102

59.1

87.1

108

63.0

95.8

117

72.0

105

128

82.6

117

141

95.6

58.2

75.8

39.4

60.6

80.4

44.0

65.7

85.8

47.7

70.4

90.7

48.3

78.9

99.7

54.7

87.4

109

63.6

43.6

59.9

23.6

45.7

65.2

28.8

49.7

69.3

33.2

54.3

74.4

38.8

60.7

81.2

39.6

68.0

89.0

44.0

Figure 37. A sample low flow table

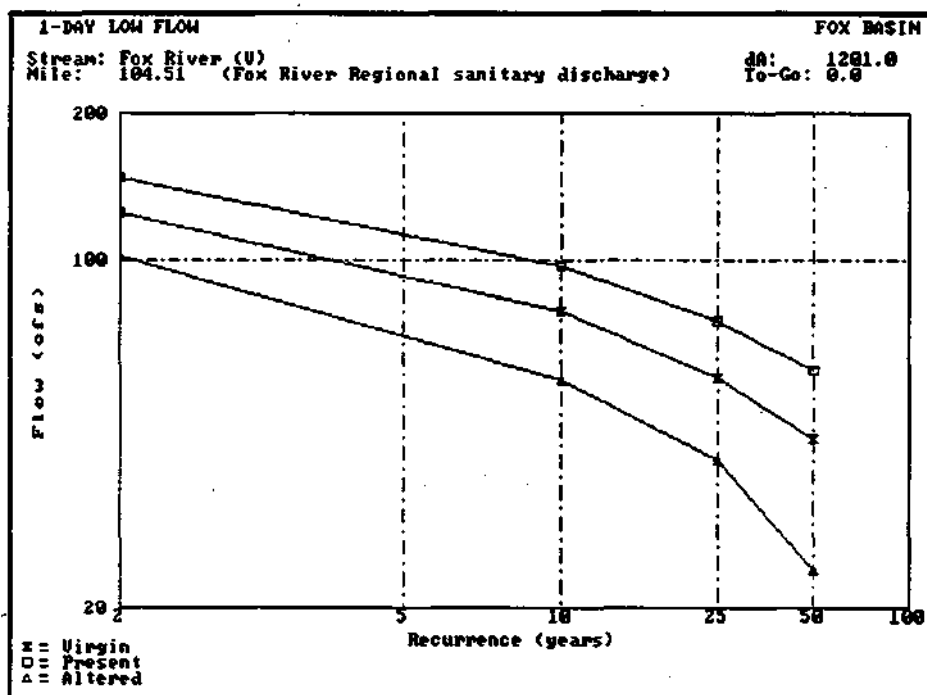


Figure 38. A sample low flow graph

DROUGHT FLOWS						
Stream: Big Rock Creek (UH)						
Mile: 0.10 (at Little Rock Creek (UHA))						
To-Go: 1.60						
dA: 192.40						
Duration (months)		Recurrence (years)				
		10	25	50	X	Δ
6		9.52	7.54	6.97	X	
		11.8	9.67	9.03	O	
		4.61	3.81	3.57		Δ
9		20.9	12.6	9.51	X	
		23.3	15.0	11.8	O	
		9.32	5.89	4.59		Δ
12		40.0	23.8	17.3	X	
		42.6	26.3	19.6	O	
		22.6	10.5	7.69		Δ
18		52.9	28.4	20.2	X	
		55.6	31.0	22.7	O	
		35.6	12.4	8.93		Δ
30		85.3	46.8	33.2	X	
		88.1	49.0	35.8	O	
		68.1	29.5	15.8		Δ
54		116	69.2	50.4	X	
		119	71.9	52.8	O	
		99.3	51.9	35.8		Δ

X = Virgin Flow
 O = Present Flow
 Δ = Altered Flow

Figure 39. A sample drought flow table

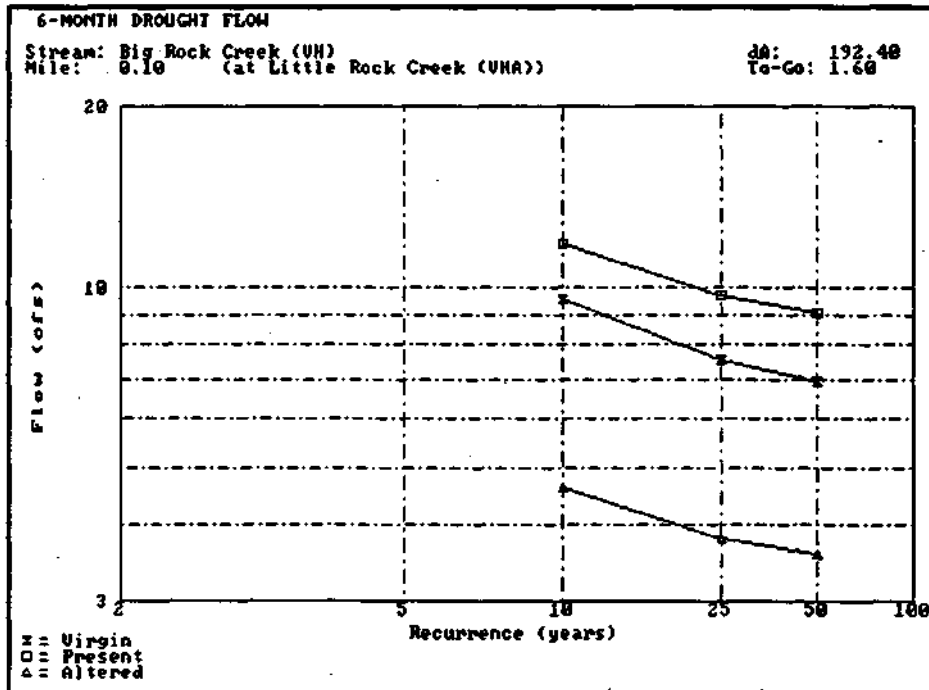


Figure 40. A sample drought flow graph

JANUARY FLOW DURATION				FOX BASIN
Stream: Fox River (U)				
Mile: 104.51 (Fox River Regional sanitary discharge)				
To-Co: 0.0				
dA: 1201.0				
Exc. Prob.	Virgin	Present	Altered	
2	2124	2176	2131	
10	1990	1954	1869	
25	1846	1827	1742	
50	1723	1722	1678	
75	1624	1623	1581	
90	1537	1566	1521	
98	139.4	120	73.4	
Avg	581	620	573	

Figure 41. A sample monthly flow-duration table

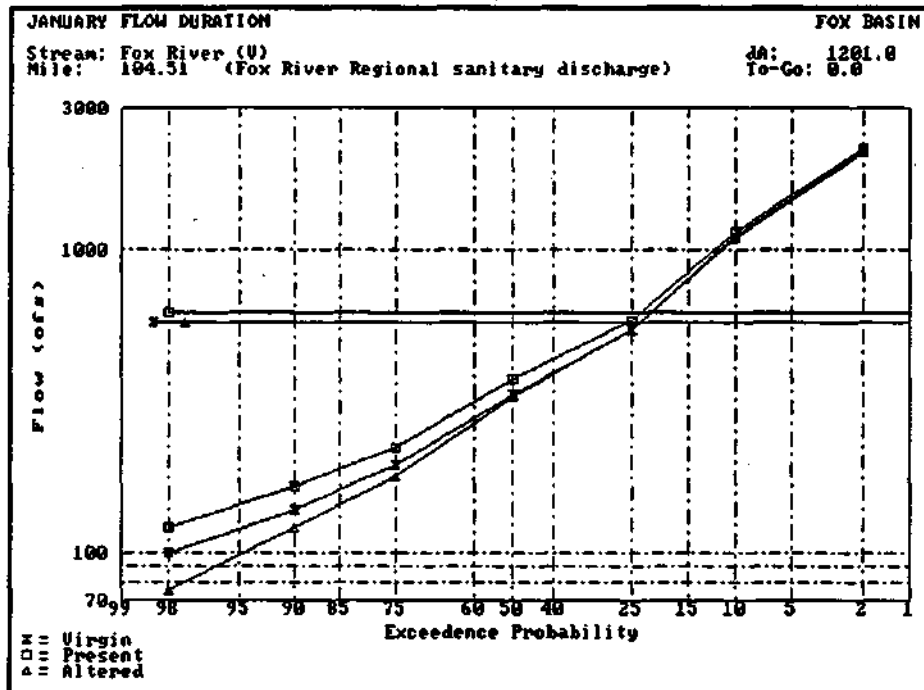


Figure 42. A sample monthly flow-duration graph

APPENDIX A. ILSAM ERROR AND WARNING MESSAGES

ILS.AM32.EXE

(.RDT file) not found. User must input.

The basin data file was not found. You must enter data for one basin.

(.INI file) not found. Using defaults.

The initialization file could not be found. ILSAM will use default values.

A minimum of zero requires you use a user-defined discharge.

If the minimum flow is zero, you should instead use the User-Defined Discharge flow modification.

Bad Qavg.

The average must not be zero.

Bad Qmax.

The maximum must not be less than the average.

Bad Qmin.

The minimum cannot be less than the average.

Can't find x of the y datafiles.

Not all of the datafiles required for the basin could be located.

Couldn't find reservoir!

ILSAM was not able to locate a reservoir.

Couldn't find stream x.

The stream code or name just entered is not among those listed for the current basin.

Error = *err*; Device = *dev*.

A critical error occurred.

EindSite could not locate stream.

ILSAM was not able to locate a stream while computing the upstream dataset.

ILSAM doesn't recognize your video adapter.

ILSAM did not detect your video card as among those required to run the model.

That point does not lie on the stream.

You are attempting to insert a river mile which does not exist on this stream.

The NETWORK K file is inconsistent.

The NETWORK file is corrupt and should be replaced with a fresh copy.

Using only first x basins.

The basin datafile contains data for more basins than is listed at the top of the file. ILSAM will only use the first x.

Zero average.

The average flow must be greater than zero.

IP.EXE

Can't find plot program.

IP could not locate the plot program (IPPLOT.EXE).

Can't run plot program.

IP could not run the plot program (IPPLOT.EXE), perhaps as the result of low memory conditions.

Can't save style sheets to file: filename.

IP could not write the list of styles to disk, perhaps as the result of insufficient disk space.

Invalid option: 'x'.

IP was invoked with an unknown option -x.

Problem reading dataset Me: filename.

IP could not read from the dataset file.

There are no styles from which to choose.

No styles exist. You must either create a style sheet file from DOS or select the Style/Create menu to define one.

IPPLOT.EXE

These errors should *never* occur. Contact the Water Survey if you receive one of these error messages.

Allocated memory contains data.

A memory allocation error occurred while initializing the plotting routines.

Invalid graphics device.

IPPLOT was run with an invalid graphics device specified.

IPPLOT does not recognize your video adapter.

Your video card was not detected to be among those needed to run IP and IPPLOT.

Memory allocation error.

There was not enough memory to initialize the plotting routines.

Points file could not be found!

IPPLOT could not locate the file created by IP containing the list of points to plot.

Unknown error.

An unspecified error occurred.

APPENDIX B. STREAMFLOW PARAMETERS AND ASSOCIATED INDEXES

Annual Flow Durations

<i>Index</i>	<i>Parameter</i>
1	Q_1
2	Q_2
3	Q_5
4	Q_{10}
5	Q_{17}
6	Q_{25}
7	Q_{40}
8	Q_{50}
9	Q_{60}
10	Q_{75}
11	Q_{85}
12	Q_{90}
13	Q_{95}
14	Q_{98}
15	Q_{99}
16	Q_{MEAN}

Drought Flows

<i>Index</i>	<i>Parameter</i>
41	6-month, 10-year
42	6-month, 25-year
43	6-month, 50-year
44	9-month, 10-year
45	9-month, 25-year
46	9-month, 50-year
47	12-month, 10-year
48	12-month, 25-year
49	12-month, 50-year
50	18-month, 10-year
51	18-month, 25-year
52	18-month, 50-year
53	30-month, 10-year
54	30-month, 25-year
55	30-month, 50-year
56	54-month, 10-year
57	54-month, 25-year
58	54-month, 50-year

Low Flows

<i>Index</i>	<i>Parameter</i>
17	1-day, 2-year
18	1-day, 10-year
19	1-day, 25 year
20	1-day, 50-year
21	7-day, 2-year
22	7-day, 10-year
23	7-day, 25 year
24	7-day, 50-year
25	15-day, 2-year
26	15-day, 10-year
27	15-day, 25 year
28	15-day, 50-year
29	31-day, 2-year
30	31-day, 10-year
31	31-day, 25 year
32	31-day, 50-year
33	61-day, 2-year
34	61-day, 10-year
35	61-day, 25 year
36	61-day, 50-year
37	91-day, 2-year
38	91-day, 10-year
39	91-day, 25 year
40	91-day, 50-year

Monthly Flow Durations

<i>Index</i>	<i>Parameter</i>	<i>Index</i>	<i>Parameter</i>	<i>Index</i>	<i>Parameter</i>
59	January, Q_2	91	May, Q_2	123	September, Q_2
60	January, Q_{10}	92	May, Q_{10}	124	September, Q_{10}
61	January, Q_{25}	93	May, Q_{25}	125	September, Q_{25}
62	January, Q_{50}	94	May, Q_{50}	126	September, Q_{50}
63	January, Q_{75}	95	May, Q_{75}	127	September, Q_{75}
64	January, Q_{90}	96	May, Q_{90}	128	September, Q_{90}
65	January, Q_{98}	97	May, Q_{98}	129	September, Q_{98}
66	January, Q_{AVG}	98	May, Q_{AVG}	130	September, Q_{AVG}
67	February, Q_2	99	June, Q_2	131	October, Q_2
68	February, Q_{10}	100	June, Q_{10}	132	October, Q_{10}
69	February, Q_{25}	101	June, Q_{25}	133	October, Q_{25}
70	February, Q_{50}	102	June, Q_{50}	134	October, Q_{50}
71	February, Q_{75}	103	June, Q_{75}	135	October, Q_{75}
72	February, Q_{90}	104	June, Q_{90}	136	October, Q_{90}
73	February, Q_{98}	105	June, Q_{98}	137	October, Q_{98}
74	February, Q_{AVG}	106	June, Q_{AVG}	138	October, Q_{AVG}
75	March, Q_2	107	July, Q_2	139	November, Q_2
76	March, Q_{10}	108	July, Q_{10}	140	November, Q_{10}
77	March, Q_{25}	109	July, Q_{25}	141	November, Q_{25}
78	March, Q_{50}	110	July, Q_{50}	142	November, Q_{50}
79	March, Q_{75}	111	July, Q_{75}	143	November, Q_{75}
80	March, Q_{90}	112	July, Q_{90}	144	November, Q_{90}
81	March, Q_{98}	113	July, Q_{98}	145	November, Q_{98}
82	March, Q_{AVG}	114	July, Q_{AVG}	146	November, Q_{AVG}
83	April, Q_2	115	August, Q_2	147	December, Q_2
84	April, Q_{10}	116	August, Q_{10}	148	December, Q_{10}
85	April, Q_{25}	117	August, Q_{25}	149	December, Q_{25}
86	April, Q_{50}	118	August, Q_{50}	150	December, Q_{50}
87	April, Q_{75}	119	August, Q_{75}	151	December, Q_{75}
88	April, Q_{90}	120	August, Q_{90}	152	December, Q_{90}
89	April, Q_{98}	121	August, Q_{98}	153	December, Q_{98}
90	April, Q_{AVG}	122	August, Q_{AVG}	154	December, Q_{AVG}

Appendix C. River Basins for which the Illinois Streamflow Assessment Model Has Been Developed

